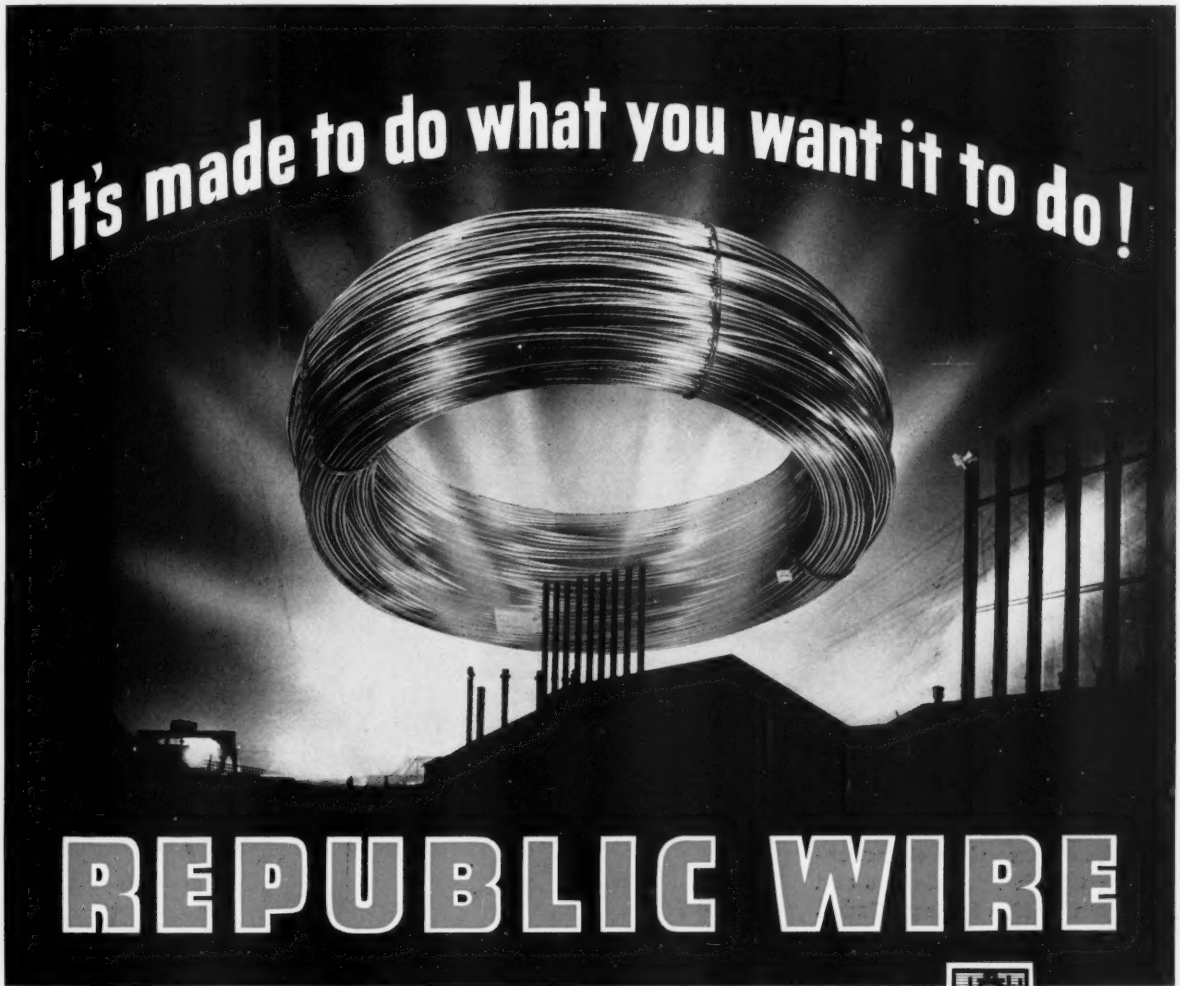
WIRE AND WIRE PRODUCTS

APRIL 1939



Republic Wire is processed to do two things: (1) To help you reduce fabrication costs—by forming, bending, crimping and knotting uniformly, coil after coil. (2) To help you advance the quality of your products—by increasing the strength and improving the finish. It will cost you nothing to investigate Republic Wire. It may cost you less to use it. **Republic Steel Corporation, Wire Division, 7850 So. Chicago Ave., Chicago, Ill.**

REPUBLIC STEEL
REG. U. S. PAT. OFF.

BERGER MANUFACTURING DIVISION
STEEL AND TUBES, INC.
TRUSCON STEEL COMPANY
NILES STEEL PRODUCTS DIVISION
UNION DRAWN STEEL DIVISION

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

INCREASED PRODUCTION

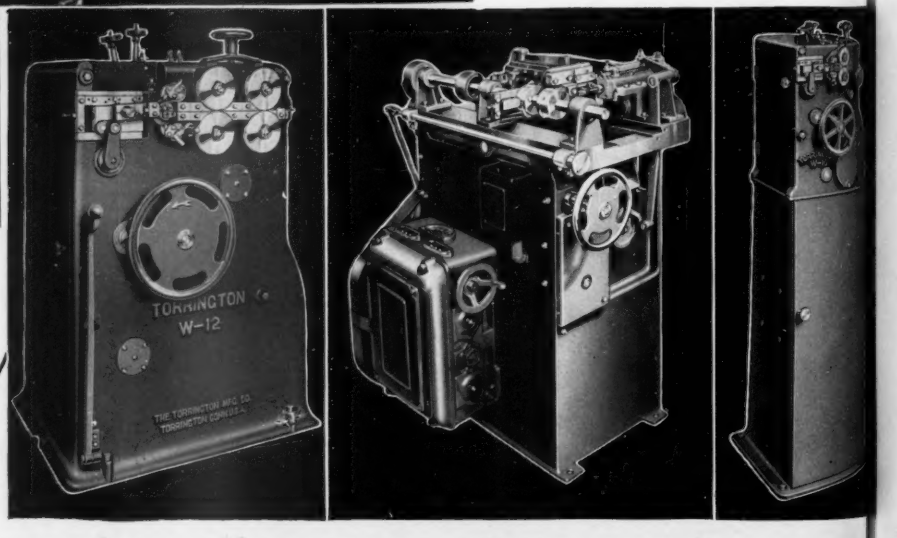
You will reduce set-up time and produce more springs per machine hour—springs formed to a new high standard of accuracy and uniformity — with Torrington Spring Coiling and Winding equipment. Scores of springmakers are adding profits and customers' good will by producing more and better springs on these machines which are compactly designed and ruggedly constructed for high-speed, easy operation and adjustment.

Investigate for yourself the many new and exclusive patented features which contribute to the superior performance of Torrington Spring Machines. Submit sample springs for guaranteed production figures. Descriptive bulletins for Segment and Clutch Type Coilers, also Torsion Spring Winders sent upon request.

Photo by Caterpillar Tractor Co.

Shown at the right are two sizes of Torrington Segment and Clutch Type Coilers and (center) a Torrington Torsion Spring Winder.

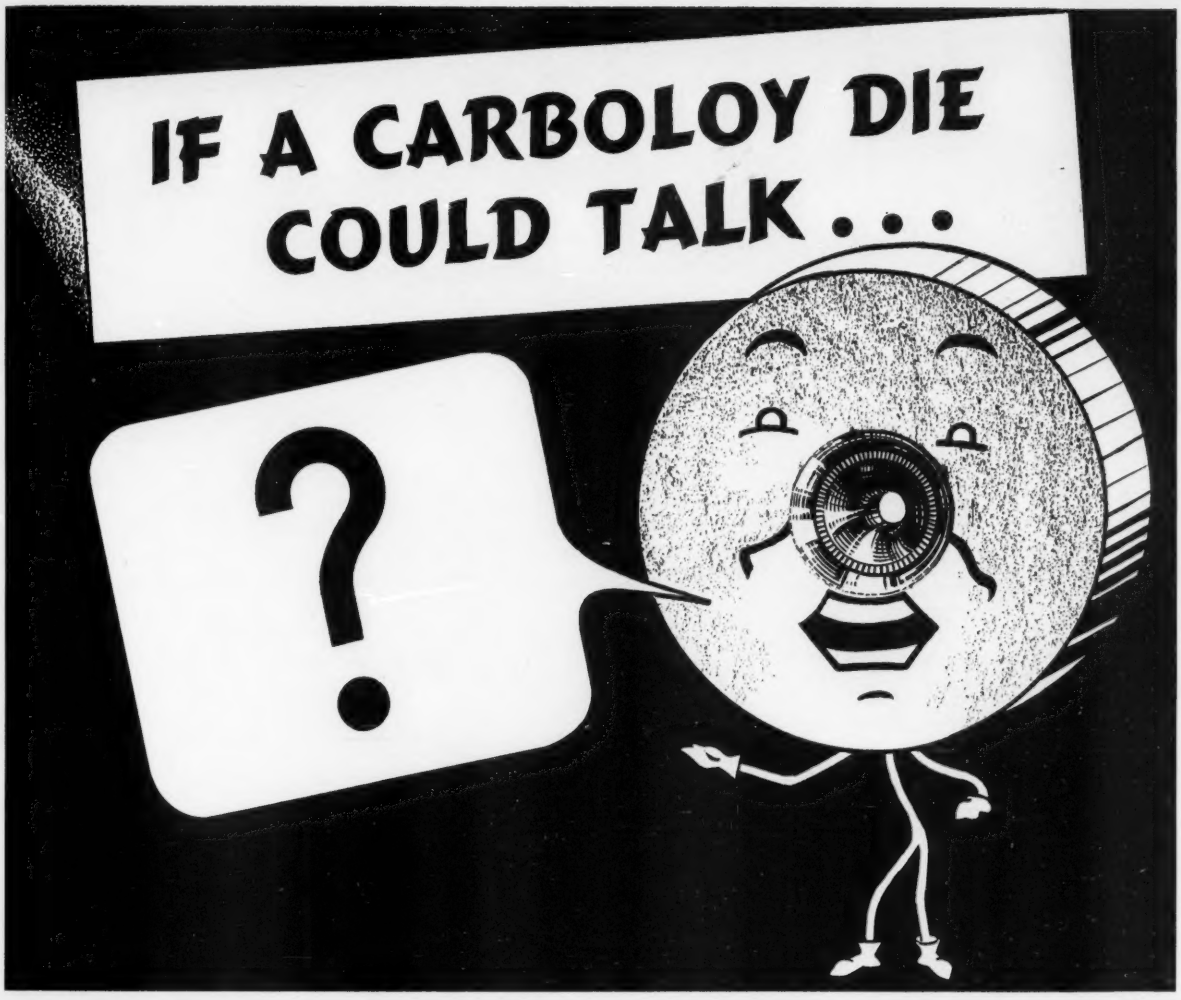
The Torrington Manufacturing Co. is associated with W. H. A. Robertson & Co., Ltd., of Bedford, England.



Spring Machines by

TORRINGTON

THE TORRINGTON MANUFACTURING CO.
TORRINGTON, CONNECTICUT • • • • U. S. A.



If a Carboloy die could talk, it would tell an unusual tale of rigid inspection for quality. Starting with the raw ore and on through to the finished product, 15 tests for quality are a standard part of the Carboloy cemented carbide manufacturing process.

This painstaking care occupies an important place in our long range program to insure uniform quality today, tomorrow and for years to come.

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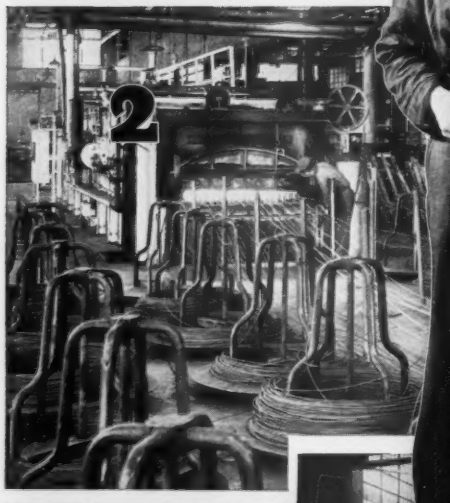
DETROIT, MICHIGAN
CHICAGO • CLEVELAND • NEWARK • PHILADELPHIA • PITTSBURGH • WORCESTER, MASS.

Authorized Distributors: Hartley Wire Die Co., Waterbury, Conn. • Canadian General Electric Co., Ltd., Toronto, Canada

CARBOLOY REG. U.S. PAT. OFF. **DRAWING AND SIZING DIES**

RODS

TAILOR-MADE TO YOUR NEEDS



All Bethlehem asks is for you to name your job for rods. We have the capacity, the modern machinery and the metallurgical background to supply you with rods in:

1 THE GRADE OF STEEL YOU WANT—Our Maryland and Cambria plants furnish rods in basic or acid open-hearth or Bessemer steels in a wide range of analyses.

2 THE HEAT-TREATMENT YOU WANT—We furnish rods patented, annealed, normalized, or spheroidized—heat-treated to fully meet the requirements of virtually every type of job for which steel rods are used.

3 THE FINISH YOU WANT—In addition to the as-rolled condition, we furnish rods pickled, limed and baked; pickled and oiled . . . finishes to meet any manufacturing need.

4 THE TONNAGE YOU WANT—Bethlehem's modern rod mills have the capacity required to fill orders of any size promptly and economically.

A Bethlehem wire-rod specialist will be glad to make his recommendations on the material best suited to your individual requirements. His suggestions are yours for the asking and may point the way toward a substantial increase in production economy.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

For Lowest Grinding Costs per Spring . . .

NORTON
DISC WHEELS

ENGINEERED to the job — that's the reason for the success of Norton Disc Wheels in cutting spring grinding costs. And they can be expertly engineered because of these Norton facilities:

1. Resinoid, silicate and vitrified bonds—whichever your particular job requires.
2. The patented Controlled Structure process of manufacture that assures uniformity throughout each disc and from disc to disc.
3. Segmental and solid type discs with mountings to fit all sizes and kinds of grinders.
4. Experienced engineers the country over to give expert help on disc wheel selection.

It will pay you to use Norton Discs on your spring grinding jobs.

NORTON COMPANY, WORCESTER, MASS.

New York Chicago Detroit Philadelphia Pittsburgh
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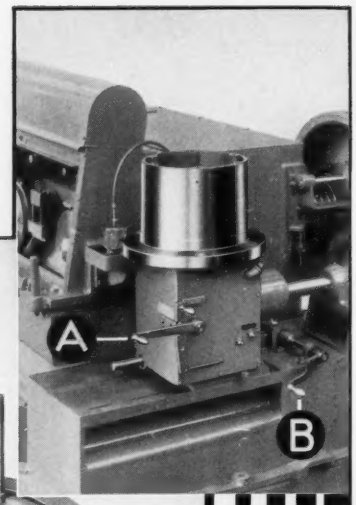
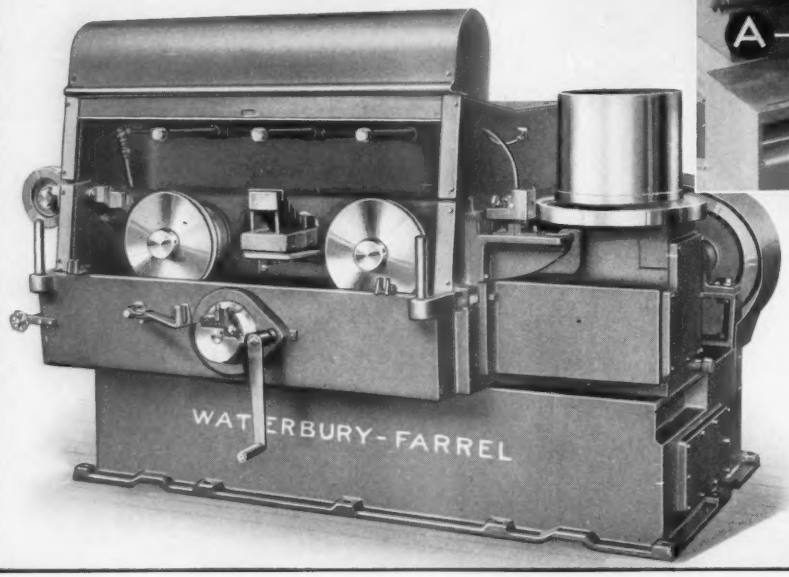
W-698

NORTON ABRASIVES

WIRE DRAWING MACHINES





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by WATERBURY-FARREL

WITH WIRE BLOCKS WHICH *rotate in either direction*

Upright Cone Continuous Machines with provision for quickly changing the rotation and position of block.

Two conveniently located removable handles do the trick in jig time—

A — changes direction of rotation
B — shifts position of block - - -

The machines are available with blocks of various diameters or with spooling devices. Our wire drawing machinery is described in Catalog W.

• WIRE AND ROD MACHINERY • COLD HEADING MACHINERY, ETC. •

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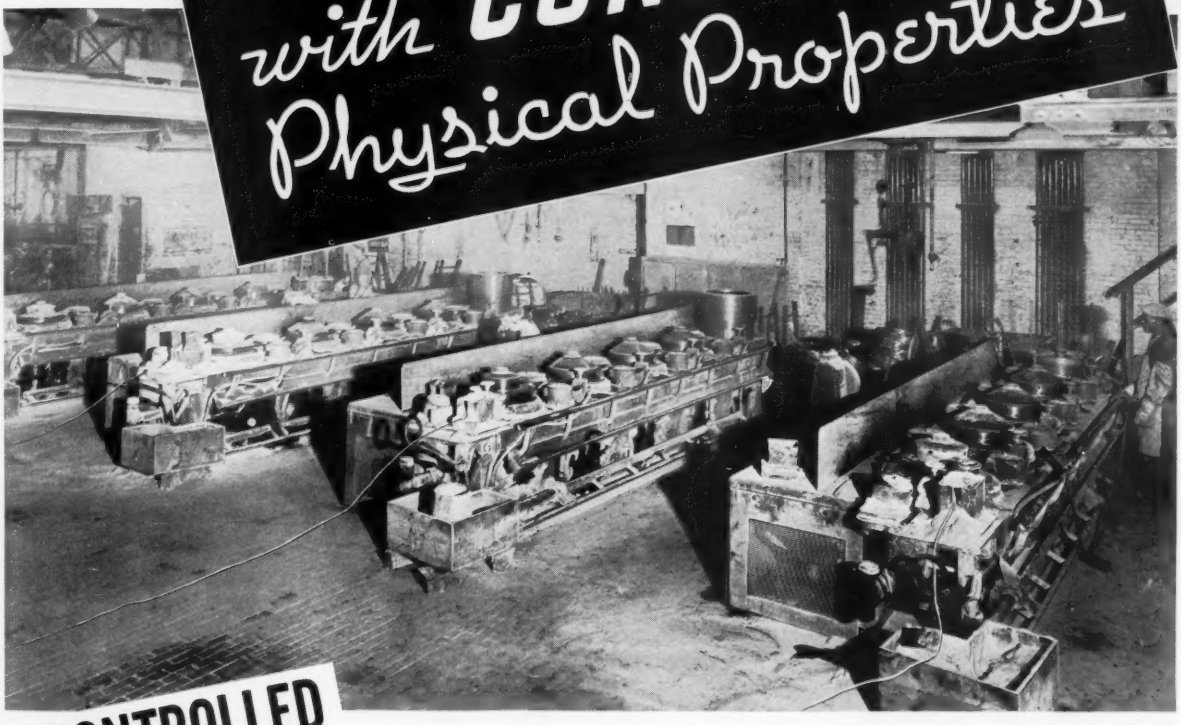
FOUNDRY & MACHINE COMPANY
WATERBURY • CONNECTICUT • U•S•A

A **Pittsburgh** DEVELOPMENT

SPRING WIRE with CONTROLLED Physical Properties



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TEMPER
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BEGINNING with the "charge" in the furnaces, we have developed an improved procedure in spring wire manufacture that results in a uniform and extraordinarily high yield of wire with the desired physical properties. Standardization of steel analysis for each size of wire, new heat treating applications that give increased uniformity, refinements in drawing technique . . . all combine to produce wire with controlled characteristics suited to specific spring fabrication needs.

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1641 GRANT BUILDING PITTSBURGH, PA.

Pittsburgh

WIRE

A COMPLETE LINE FOR ALL FABRICATING NEEDS

Fine Wires Finely Made

HUDCO

Wires for Metal Spraying

Pure Lead
Lead Alloy
Pure Zinc
Zinc Alloy
Copper
Tin
High Brass
Low Brass
Solder Wire
Cadmium
Nickel Silver (10%, 18%, 30%)
Aluminum
Monel Metal
Phosphor Bronze
Pure Nickel
Commercial Bronze

* * *

High Conductivity Electric Wire

* * *

Brush Wires, Crimp and Straight (Brass, Steel, Nickel Silver, Copper and Phosphor Bronze)

HUDCO

Fine Bare Wires

High Brass
Low Brass
Zinc 99.99 and High Tensile Zinc
Commercial Bronze
Phosphor Bronze
Pure Tin
Lead
Antimonial Lead
Cadmium
Nickel Silver, 10%, 18%, and 30%
Silver Plated Copper
False Gold and Special Brass and Bronze Alloys to Specification

* * *

Tinsel Lahns, Silver Plated Copper, False Gold and Copper

* * *

Metallic Fibre For Packing Purposes, Copper, Bronze, Zinc, Lead and Aluminum

WINCO

Leakproof Enameled Wires drawn from special oxygen-free copper. There are no oxide inclusions which produce surface defects such as slivers. Perfect enameling is assured. Every spool is mercury-tested before shipment.

* * *

The Winco line of wires also includes enameled wires in all standard and special coverings made to meet exacting requirements.

* * *

Samples of Leakproof and other Winco Enameled Wires sent on request.

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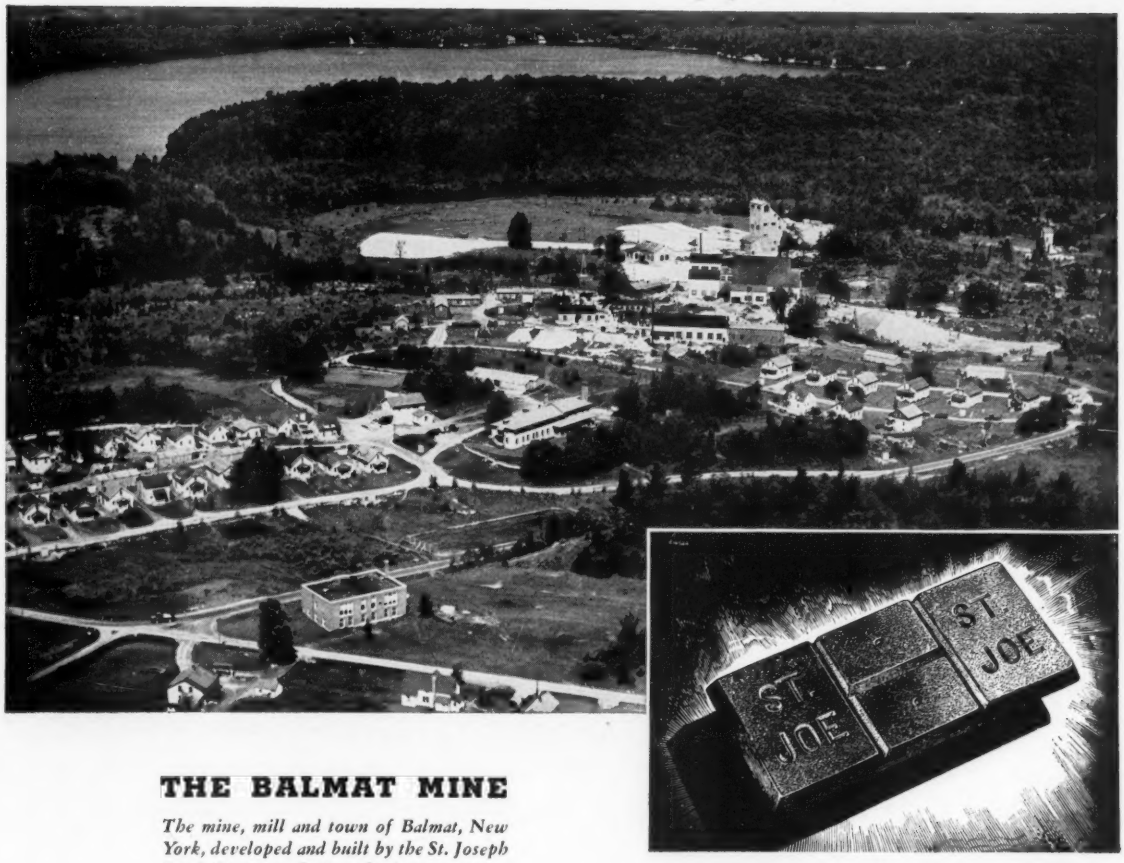
OSSINING, N. Y.

ESTAB. 1902 — Successors ROYLE & AKIN — ESTAB. 1902

FROM ORE TO METAL

The Story of St. Joe Electro-Thermic Zinc—Number 1 of a Series



THE BALMAT MINE

The mine, mill and town of Balmat, New York, developed and built by the St. Joseph Lead Company during the last ten years.

CLOSE TO THE BEAUTIFUL FOOTHILLS of the Adirondack Mountains, hidden for untold centuries under forest and lake, lay the great zinc deposit now known as the Balmat Mine.

Developed in 1927 and 1928 by the St. Joseph Lead Company, this great ore body which on the surface was a thinly mineralized non-commercial limestone, is currently shipping, with the old "Edwards mine" ten miles away, 60,000 tons of zinc concentrates, and 70,000 tons of iron pyrites per year.

One of the greatest zinc deposits in the United States, its large ore reserves are available for the smelter and refinery of the St. Joseph Lead Company at Josephtown, Pennsylvania, where the new St. Joe electro-thermic grades of zinc are produced.

ST. JOSEPH LEAD COMPANY

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PLANT AND LABORATORY, JOSEPHTOWN, BEAVER COUNTY, PENNSYLVANIA

The WIRE ASSOCIATION

WORCESTER REGIONAL MEETING

WILL BE HELD AT WORCESTER, MASS.

Tuesday, April 25, 1939

✦ ✦ ✦ GENERAL PROGRAM ✦ ✦ ✦

Headquarters Will Be At The Hotel Bancroft.
1:30 P. M. Visit To Plant Of The Norton Company.
6:00 P. M. Informal Dinner At Hotel Bancroft.

▲▲▲

7:30 P. M. Wire Association Meeting — Hotel Bancroft

Paper: "Trouble Shooting With Metallography"

By C. G. Johnson,
Assistant Professor of Mechanical Engineering,
Worcester Polytechnic Institute

Paper: "The Role of Abrasives in the Wire Industry"

By M. F. Beecher,
Engineer, The Norton Company,

Papers To Be Followed By Informal Discussions On Subjects Presented

— COMMITTEE IN CHARGE —

R. R. TATNALL . . Metallurgist, Wickwire-Spencer Steel Co., Worcester, Mass.
CHAIRMAN

K. B. LEWIS . . . . . Consulting Engineer, Worcester, Mass.
S. EKSTROM . . . Works Mgr., N. E. High Carbon Wire Co., Millbury, Mass.
R. V. OLSON . . . President, Mossberg Pressed Steel Corp., Attleboro, Mass.
EUGENE ROTH . . . Manager, The Carboloy Co., Inc., Worcester, Mass.
P. A. BEAMAN, Sales Mgr., Wire Mach. Div., Morgan Construction Co., Worcester, Mass.
EARLE H. THOMAS . . Superintendent, George W. Prentiss Co., Holyoke, Mass.

All Wire Mill Men Are Invited To Attend This Meeting
Cards of Admission May Be Obtained From
Richard E. Brown, Secretary,
THE WIRE ASSOCIATION,
17 E. 42nd St., New York, N. Y.

(After April 10th Address Will Be Stamford Trust Co. Bldg., Stamford, Conn.)

The WIRE ASSOCIATION

PITTSBURGH REGIONAL MEETING

WILL BE HELD AT PITTSBURGH, PA.

Friday, May 5, 1939

✦ ✦ ✦ GENERAL PROGRAM ✦ ✦ ✦

Headquarters For Registration And Assembly
Prior To Plant Inspection Will Be At The
William Penn Hotel.

Transportation Will Be Furnished by The
Westinghouse Electric & Manufacturing Company

▲▲▲

12:00 M. — Luncheon at the East Pittsburgh Plant by courtesy of the Westinghouse Electric & Manufacturing Company.

Afternoon — Inspection Trip Through The Plant Of The Westinghouse Electric & Manufacturing Company.

6:00 P. M. — Informal Dinner At The William Penn Hotel.

▲▲▲

7:30 P. M. — Wire Association Meeting — William Penn Hotel

— TECHNICAL PAPERS — OPEN FOR DISCUSSION —
will be presented by well known wire men at the evening meeting in The William Penn Hotel.

Papers to be Followed by Informal Discussions on Subjects Presented

COMMITTEE IN CHARGE

A. E. GLEN,
The Carboloy Co., Pittsburgh, Pa.
CHAIRMAN

L. M. GUMM, Manager of Sales, Iron & Steel Section, Industrial Sales Dept., Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

R. E. BROWN, Publisher, Wire & Wire Products, New York, N. Y.

All Wire Mill Men Are Invited To Attend This Meeting
Cards of Admission May Be Obtained From Members of
The Committee in Charge or From
Richard E. Brown, Secretary,
THE WIRE ASSOCIATION,
17 E. 42nd St., New York, N. Y.

(After April 10th Address Will Be Stamford Trust Co. Bldg., Stamford, Conn.)

CLEVELAND TRAMRAIL

Complete Systems for Overhead Handling of Materials and Products in All Departments of the Wire and Wire Products Industry

- There is Cleveland Tramrail to meet the needs of All industries—
- For handling of material and product to and through manufacturing processes—also for warehousing and loading.

ALSO BUILDERS OF CLEVELAND CRANES ALL WELDED

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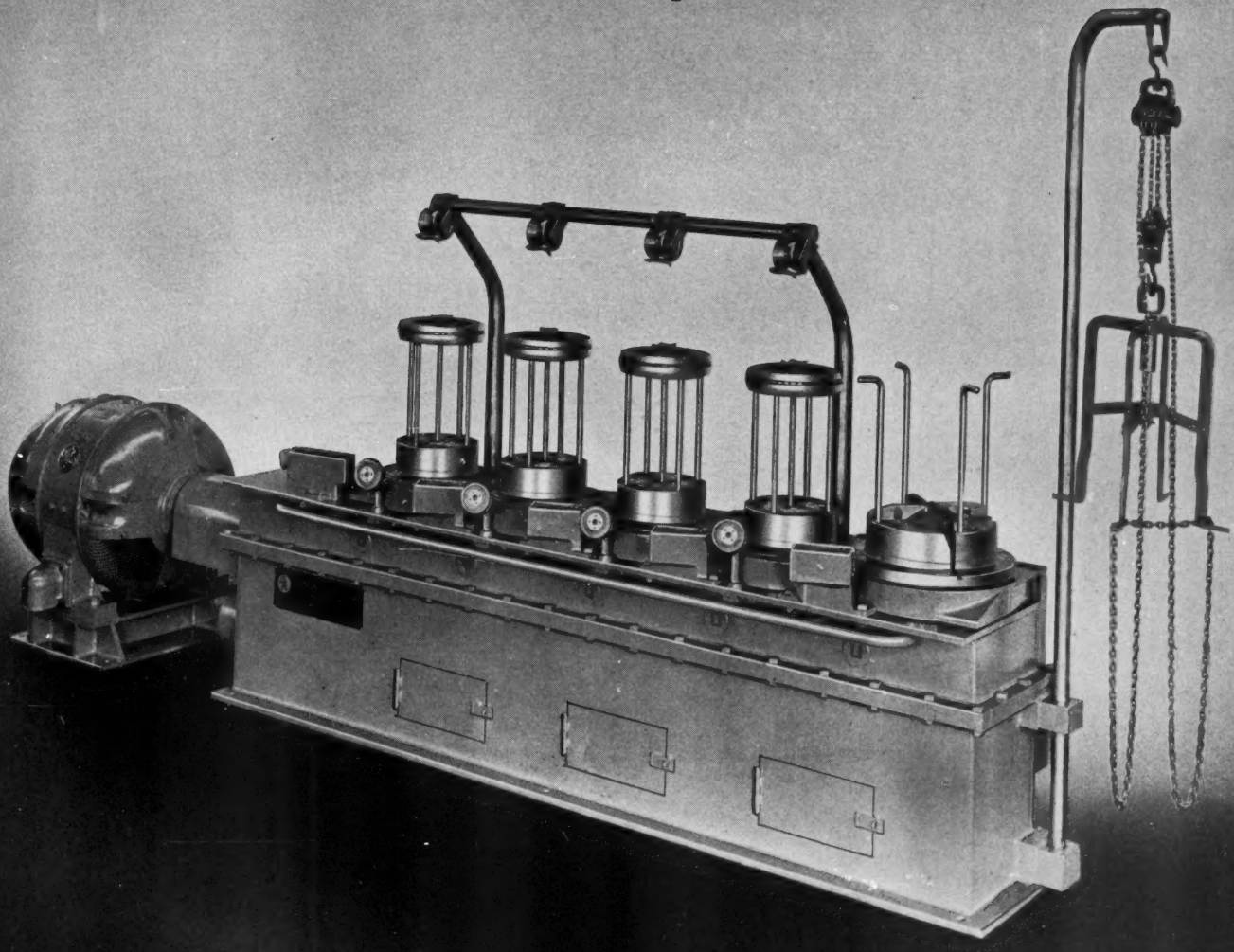
AETNA GROUP DRIVEN

Wire Drawing Machine



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Among Important Features Are:

❶ Overhead take-off, which reduces threading time. ❷ Rigid die boxes, which facilitate rapid and accurate casting.

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CONSULTANTS—DESIGNERS AND BUILDERS TO THE STEEL AND NON-FERROUS INDUSTRIES

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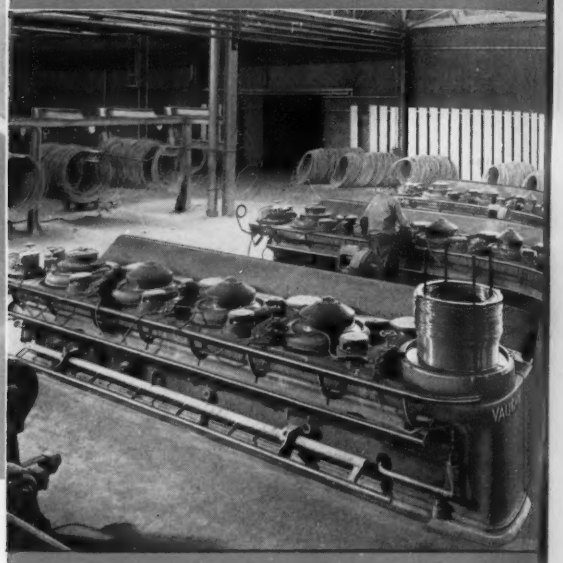
FASTER HANDLING



the NET OF PROFITABLE OPERATION IN TODAY'S WIRE MARKETS

Your operations-dollar must return its face value *and more* in production this year, if you are to meet the challenge to already-slender profits presented by expensive labor and shortened hours.

You can accomplish these objectives with Vaughn Wire Drawing Machinery—because in the modern MOTOBLOC and MOTOBLOX you get the safe high speeds that cram more minutes in each working hour . . . the flexibility and adaptability that "follow the ball" however varied your orders may be.

Give your sales-force the constructive confidence that goes with sure, fast-stepping handling of production in your plant—let Vaughn Machinery set a better pace for you!

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO, U.S.A.

Complete Wire Drawing Equipment . . . Continuous or Single Hole . . . For the Largest Bars . . . For the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

VAUGHN
WIRE DRAWING MACHINERY

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 14 APRIL, 1939 No. 4

Designated as

Official Publication By The Wire Association

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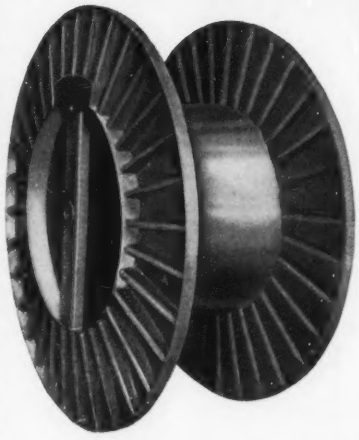
FOR REEL ECONOMY



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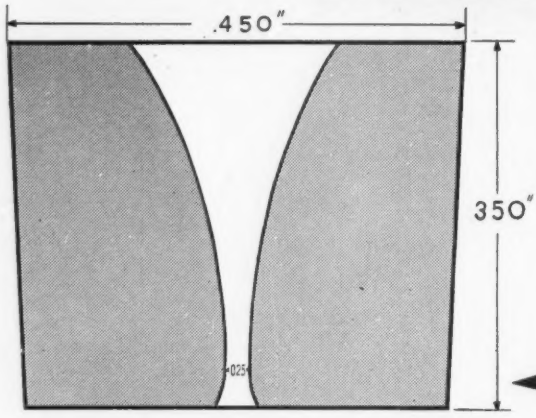
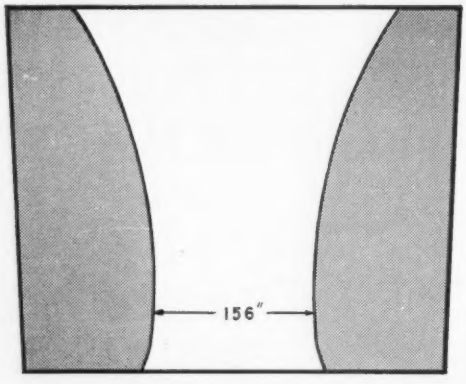


EXTRA PERFORMANCE

at no extra cost . . . . . .

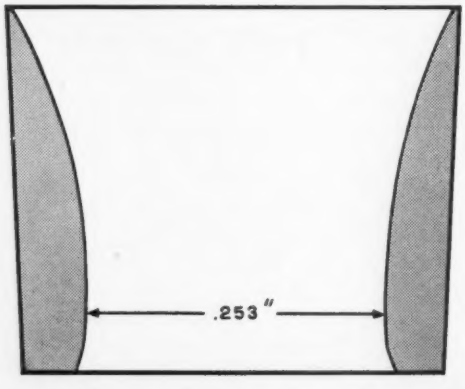
The FIRTHALOY Die Nib illustrated is one of two that produced 4,811,211 pounds of perfect finished wire.

DIES WERE PURCHASED AT SIZE .025"



GUARANTEED TO RECUT TO .156"

(Where they had drawn 1,291,250 lbs.)



THEY ARE STILL IN SERVICE AT .253"

Having produced 4,811,211 lbs., or 3,519,961 lbs. over guaranteed value.

Initial cost may be high but FIRTHALOY Dies are the cheapest in the long run.

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CLEVELAND DAYTON
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McKEESPORT, PA.

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 14 APRIL, 1939 No. 4

Westphal Re-elected President of Wire Association

Wire Association reelects officers — Directors appoint program committee — approve change of address — establish Mordica Memorial Lecture — confirm Regional Meeting arrangements. ✦ ✦ ✦ ✦

AT the annual meeting of the Board of Directors of the Wire Association, held at the Waldorf Astoria Hotel, New York, on March 10, 1939, the following officers were reelected for the 1939-40 term:

President—F. A. Westphal, Superintendent, Wire Mills, Sheffield Steel Corp., Kansas City, Mo.

Vice President, Ferrous Division—John C. Callaghan, Works Manager Canada Works, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada.

Vice President, Non-Ferrous Division—E. W. Clark, Mechanical Engineer Wire & Cable Section, General Electric Co., Schenectady, N. Y.

Executive Secretary—Richard E. Brown, Publisher, "WIRE & WIRE PRODUCTS," New York City.

✦ ✦ ✦

IN accordance with the established policy of the Association these officers are all retired at the end of their present term—having served two consecutive years—and will be replaced by an entirely new group.

✦ ✦ ✦

AT this meeting, the four new Directors, whose three-year terms of office commenced with the March, 1939, Directors' Meeting, were seated. These new Directors are:

D. D. Buchanan, Assistant General Manager, Union Drawn Steel Division, Republic Steel Corp., Massillon, Ohio.

C. E. Johnson, Superintendent, Rod & Wire Mills, Bethlehem Steel Co., Sparrows Point, Md.

John A. Moritz, Superintendent, Wire Mills, Keystone Steel & Wire Co., Peoria, Illinois.

Sidney Rolle, Assistant Manager, Scomet Engineering Co., New York City.

✦ ✦ ✦

THE Directors' Meeting was followed by a luncheon with about thirty members of the Association present. At this luncheon, Mr. Westphal, the President of the Association, spoke, as did Major L. J. Harris, Procurement Planning Officer for the New York Area, Signal Corps, United States Army.

Mr. Westphal said:

"IT is with great pleasure that we welcome the new members to our Board of Directors, namely D. D. Buchanan of Union Drawn Steel Company, C. E. Johnson of Bethlehem Steel Corporation, John A. Moritz of Keystone Steel and Wire Company and Sidney Rolle of the Scomet Engineering Company. Furthermore, we are pleased that the membership again re-elected our past president, Mr. R. K. Clifford of Continental Steel Corporation, for another term of three years.

✦ ✦ ✦

I WISH to express a word of appreciation and thanks to the retiring directors, namely H. B. Carnahan of Canada Wire & Cable Company, Kenneth B. Lewis, Consulting Engineer, W. D. Pierson of Waterbury-Farrel Foundry & Ma-

chine Company and R. S. Simmons of Keystone Steel & Wire Company.

✦ ✦ ✦

ALL of these men have taken a vital interest in the progress of the Wire Association and have donated commendably their share of work and responsibility. Mr. Pierson is actually one of the founders of the Wire Association. I believe special mention should be given Kenneth B. Lewis, who is also a founder, and not only has he given to us generously of his time and talent, but in the opinion of many of us he is the best historian of the wire industry, and as well one of the best informed and a possessor of a huge fund of knowledge. We may regard him as the elixir of the Wire Association.

✦ ✦ ✦

WITHOUT working on one's emotions or being an alarmist, but instead, facing the facts with cool deliberation, it is believed that the Wire Association, along with other professional societies, should take full cognizance of a possible national war-time emergency due to the potential international crises facing the peoples of the democratic nations against the totalitarian nations.

✦ ✦ ✦

THE Wire Association has an intensely patriotic viewpoint, as exemplified in our Detroit convention of October, 1938 when we listened to the spirited message of the Honorable Louis A. Johnson, Assistant Secretary of War. We became particularly sensitive of preparedness in relation to industrial mobilization in war-time, or the so-called "M" Day—Mobilization Day for our armed forces, as well as industry.

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JUST recently it was the duty of the Wire Association to pass an opinion on the formation of tentative war contracts, and with that in mind it is entirely fitting that the following three points should be strongly suggested in future legislation for the welfare and benefit of our nation. They are briefly discussed as follows:

(1) For the cause of National Defense in the event of war and for the benefit of industry, it is believed that interwoven in the whole set-up of preparedness and war-time emergency adequate provisions and regulations should be made to prevent labor strikes, sit-down strikes, pillaging and sabotage incident to labor difficulties. Totalitarian nations call it treason to retard or block industrial production, therefore democratic nations should likewise adopt the same attitude.

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FREDERICK A. WESTPHAL
Superintendent of Wire Mills,
Sheffield Steel Corp., Kansas City, Mo.
President, The Wire Association

Born Holyoke, Mass., 1895. Graduate U. S. Naval Academy. Four years with American Steel & Wire Co. In 1922 Assistant Superintendent, Rod and Wire Works, Jones & Laughlin Steel Corp., Aliquippa, Pa. In 1928 Superintendent of Wire Mills, Sheffield Steel Corp., Kansas City, Mo. During World War served as Officer Sixth Field Artillery — severely wounded in action — twice cited and decorated for gallantry in action and meritorious services.

It is suggested that the "Cost of Living Index," as established by the Department of Commerce or Labor for the different regions of the nation, should be the future guide in ascertaining increased wages to ward off strikes or difficulties from this particular cause during war-time.

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A lesson of these despicable conditions in war-time was learned in England during the World War, at which time English labor working on munitions struck, with the result that the army at the front was disastrously short of necessities for combat directly due to the strikes of labor.

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Furthermore, another lesson was learned in the United States when labor struck during 1917-18 periodically in several localities while this nation was striving to equip men for the field of action. It is felt that this point cannot be emphasized too strongly—that strikes and unfair tactics by labor agitators should be controlled by law just as the whole war-time contract set-up for manufacturers, as covered by the National Defense Act, is the controlling law for industry.

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(2) The procurement of munitions for the Army and Navy should be under the jurisdiction and authority of one unified department for contracts and purchases. Today the Army and Navy purchase independently of one another, therefore, it is believed that for the cause of National Defense and to attain equalization of contracts, in a war-time emergency it would be under more efficient control to have uniformity of procedure and allocation come from one and the same authority.

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(3) At this time our nation is vulnerable and subject to espionage from other nations. Apparently the United States is looked upon as "easy picking," and that is really a fact because we have no set-up or laws with teeth in them to protect our projects and plans for National Defense. There should be an enlargement of the intelligence sections of the Army and Navy, and a suitable legislative program should be adopted to protect, give fair and swift trials and suitable severe penalties for offenses, directly or indirectly, against our government or the cause of National Defense.

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MANUFACTURERS, and industry as a whole, at this time should become sensitive to just what industrial mobilization and preparedness means. The chances may be that in the next war our enemy might strike quickly and not give us time to build and prepare as in the World War of over twenty years ago, therefore, whatever cooperation industry can give in organizing and obtaining coordination in supplying munitions for **that time** of conflict, it shall be of utmost importance to our nation. We should be on the alert, encourage and cooperate to attain quick industrial mobilization for the protection of our homes, country and the cause of National Defense.

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IN conclusion, I wish to express my appreciation of the honor bestowed upon me by being re-elected president for the ensuing year. Again I approach this job with a high sense of duty and an earnest desire of continued cooperative action and harmony throughout. Progressive and constructive thought and action is the pulse of the situation for all of us to pursue.

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TWO years, in my opinion, is enough to serve as President

of the Wire Association, therefore, I thoroughly believe that I should be succeeded one year hence.

I thank you."

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The Directors' Proceedings

AT the Directors' Meeting the matters first discussed were finances and membership. Both have shown constant improvement during the past year, and the membership of the Association on March 1, 1939, was 345, a net increase of 25 during the year.

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Membership

THERE was a discussion of ways and means to develop membership and some very constructive suggestions made which will be carried out by the Executive Secretary during the next few months.

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Questions and Answers

IN discussing the activities of the Wire Association, it was brought out that the Question and Answer Service between members had shown a constant growth, and that many vexing technical problems had been solved for members. This technical service is of course available only to members of the Association. Information as to sources of supply for machinery, materials and mill equipment is furnished to any subscriber to "WIRE & WIRE PRODUCTS" as a part of the publication service to its readers, and will be, of course, continued as usual.

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New Headquarters

THE change of address on April 15, 1939, to the Stamford Trust Company Building, 300 Main Street, Stamford, Connecticut, was discussed by the Board and the move approved. In this connection, it was brought out that ten of our foreign members visited the Association office during the past eight months.

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Establishment of the Mordica Memorial Lecture

AT the Directors' Meeting held at Detroit in October, 1938, the idea of establishing an annual Wire Association Lecture to be

JOHN C. CALLAGHAN
Works Manager, Canada Works, Steel Co. of Canada. Vice- President, The Wire Association.

presented at the annual meeting was first discussed.

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THE thought behind the lecture is that in this way the Association would be provided with an opportunity to honor various individuals who have done outstanding work and at the same time incorporate their names in Wire Association activities.

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JOHN MORDICA was the first President of the Wire Association, and his name is also honored in the establishment of this annual lecture.

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THE joint program committee will select a lecturer for the 1939 Convention, and announcement will be made at a later date of the selection of the lecturer and the subject to be presented.

E. W. CLARK
Mechanical Engineer, Wire and Cable Section, General Electric Co., Schenectady, N. Y., Vice President, The Wire Association.

Proposal for Research Fellowship

A PROPOSAL to establish a Wire Association Research Fellowship at one of the National Research Institutions was presented. It was decided that the Association was not in a position to undertake an activity of this kind at this time.

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Joint Program Committee for 1939 Annual Convention In Chicago

(This committee will also select the lecturer for the John Mordica Memorial Lecture).

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THE President appointed the following as members of the Joint Program Committee for the 1939 annual convention.

Ferrous

Chairman

J. K. Beeson, Assistant Manager of Sales, Pittsburgh Steel Co., Pittsburgh, Pa.

COMMITTEE

N. C. Harrison, Vice President, Atlantic Steel Company, Atlanta, Ga.

D. D. Buchanan, Assistant General Manager, Union Drawn Steel Div., Republic Steel Corp., Massillon, Ohio.

C. E. Johnson, Superintendent, Rod & Wire Mills, Bethlehem Steel Co., Sparrows Point, Md.

John C. Callaghan, Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada, (ex-officio).

Non-Ferrous

Chairman

Sidney Rolle, Assistant Manager, Scomet Engineering Co., New York City.

COMMITTEE

William H. Bassett, Jr., Manager, Metallurgical Development, Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.

E. W. Clark, Mechanical Engineer, Wire & Cable Section, General Electric Co., Schenectady, N. Y.

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1939 Activities

Regional Meetings

THE activities of the Association for 1939, as authorized by the Board of Directors, consist of three Regional Meetings and the Annual Convention.

(*Please turn to Page 239*)

Measuring Contour of Diamond Dies for Copper Wire Drawing

By L. B. Barker,
Schenectady Works Laboratory,
General Electric Company

A study of the general considerations involved—the configuration of the dies — the checking of shapes — the measuring technique—efficacy of method. ✦ ✦ ✦ ✦

General Considerations

COPPER is normally very ductile and capable of undergoing severe cold working without failure—a fact particularly evident in the process of drawing wire. It is essential that this ductility be preserved in the finished wire to ensure its fitness for most applications and as an indication that the wire has been properly drawn and annealed. A consideration of all the factors which influence the ductility of finished wire is outside the scope of this article. We are concerned here with only one of these factors: the shapes of the dies (Fig. 1) used in drawing the wire and, more particularly, a method for measuring these shapes which has proved very effective in distinguishing a good die from a poor one.

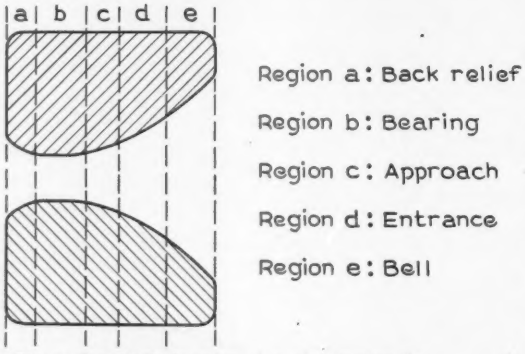

Fig. 1. Longitudinal section of a wire-drawing die.

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Die Shapes

A GREAT deal of study has been devoted to die shapes and as a result there is general agreement on the fundamental dimensions. In bonded-tungsten-carbide dies these dimensions are very rigidly adhered to. Dies of this type are quite generally used for the larger sizes of wire down to about 0.064 in. (No. 14 Awg) and in this size range the gauging methods available enable the wire manufacturer to detect any deviation from the accepted standard.

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AS the drawing proceeds to the smaller sizes diamond dies are used. There is every reason for having these dies held as closely to dimensional standards as the tungsten-carbide dies are held. Otherwise, wire which has been drawn to an intermediate size with properly shaped tungsten-carbide dies and is then drawn to finish size with diamond dies, may or may not be up to standard depending on the chance occurrence that among the diamond dies there may be one or more whose shapes are definitely "off."

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Fig. 2. Three fusible-alloy casts, one as "poured" in the die, for obtaining profile measurements. ✦

Checking of Die Shapes

FOR checking the shapes of diamond dies there is in general use no method which compares in convenience and accuracy with those used for tungsten-carbide dies. The common method of determining whether a diamond die is fit for service is to give it a visual inspection for flaws and then place it on a machine and draw wire with it. If no trouble is experienced, it is assumed that the die shape is satisfactory. Unfortunately, the ability of copper to stand abuse in a drawing machine depends largely on its oxygen content; thus an "off" die, which might draw low-oxygen copper without trouble, would cause breakage or a "cuppy" condition with wire having a higher oxygen content. There is, therefore, a definite need for a method of checking diamond dies which is easy to use and which provides enough information to determine whether a die is likely to cause trouble in service.

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THE shape of a wire-drawing die can be conveniently studied by using

the die as a mold and making a cast of fusible alloy. This is commonly done with large dies and presents no difficulties. With small dies the surface tension of the metal becomes a factor and a cast which has been made by simply pouring the metal into the die will not have flowed into the bore of the die. The effect of the surface tension, however, can be counteracted by dropping the metal into the die from a height of two to four inches, making what might be called a drop cast. The impact forces the metal into the bore where it solidifies instantly, permitting only a small quantity to pass on through. A cast made this way is easily withdrawn from the die since, with proper manipulation, no part of the cast below the bore will be larger than the bore itself.

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DROP casts have been made of diamond dies in sizes ranging from 0.072 to 0.010 in. (No. 13 to No. 30 Awg). The metal used for the present work is the quaternary eutectic of tin, bismuth, lead, and cadmium, which has a melting point of 70 C. It is kept on hand in a small evaporating dish at a temperature of about 80 C. In making a cast, a small amount of the metal is picked up with an ordinary medicine dropper and dropped into the die from a suitable height. The die is at room temperature. Enough metal is dropped to form a large button on the surface of the die, thus providing a ready means of gripping the cast with the fingers. The entire process takes only a few minutes and requires only moderately expert manipulation. In Fig. 2 are shown several such casts, one of which has not been removed from the die. Fig. 3 shows one of the casts at a magnification of approximately 18 diameters.

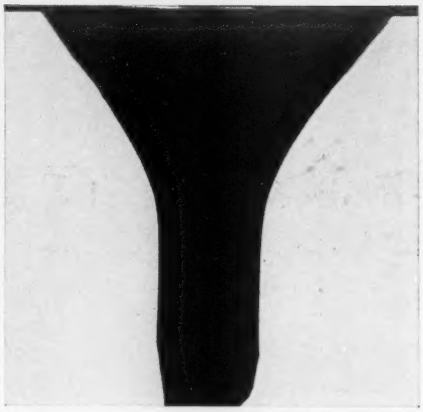

Fig. 3. Profile cast of a die (magnified approx. 18 X).

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Measuring Technique

THE only measurements which are actually made by means of these casts are those of the approach angle and the diameter of the bore. The length of the bearing can only be approximated as the cast does not reproduce the complete contour of the die. Rubber plugs vulcanized in the die offered promise in this respect and were tried out in the earlier stages of the present work. However, with the types of rubber available the rubber plug did not mold true to the shape of the die. The use of rubber was therefore given up in favor of the metal casts. The measurement of the approach angle of a die does not form a complete basis for predicting how the die will work in service, but it is a safe assumption that no die will work satisfactorily whose approach angle is too far off standard and there is therefore merit in a checking setup which makes this measurement.

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REFERRING again to Fig. 1, it will be noted that the approach angle shown is constant in value; that is, it is the same over the entire area of contact with the wire. If all dies conformed to this standard it would be a simple matter to place a cast under a microscope and measure the approach angle with a goniometer eyepiece. However, practically all of the diamond dies so far examined have a curving approach as shown in Fig. 3 and the approach angle can only be approximated by measuring the angle between the tangents at the points of first contact. An arrangement for doing this is shown in Fig. 4. This equipment consists of a standard compound microscope, fitted with a mechanical stage and substage illumination, a camera lucida, and a special viewing surface which is shown in the left foreground. A cast is placed on the stage of the microscope with its axis in a horizontal position and parallel to the side of the

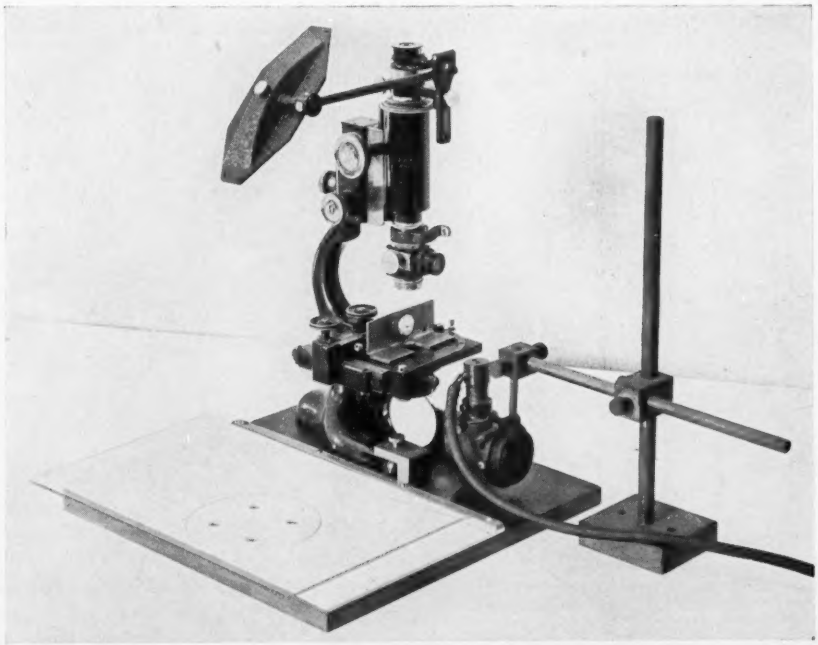

Fig. 4. Complete setup of microscope and camera lucida, for measuring diameter and approach angle of the die.

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stage. With the illumination properly adjusted, the observer sees the cast as a sharply outlined silhouette (Fig. 5), projected on the viewing surface beneath the mirror. With the type of camera lucida used, the darkness of the silhouette can be adjusted so that the lines on the viewing surface are clearly visible and easily compared with the outlines of the silhouette. The method of measuring the approach angle is shown in Fig. 6, which is self explanatory.

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Practical Test of Method

A TEST designed to show the value of the method as a means of inspecting dies gave very encouraging results. Two sets of dies for drawing 0.081 to 0.0226 in. (No. 12 to No. 23 Awg) were selected from stock on the basis of their approach angles. Set No. 1 was made up of dies whose approach angles were 30 deg. or under; Set No. 2 of dies whose approach angles were 35 deg. or over. A machine which was drawing 0.0226 in. (No. 23) from 0.081 in. (No. 12) in regular production was stopped, its dies removed, and the machine restrung with Set. No. 1. Drawing was resumed with no difficulty and continued until half a reel of wire had been obtained. The machine was then stopped, the first set of dies removed, and the machine restrung with Set No. 2. The wire broke when about 50 ft. had been drawn. The operator attempted to restring the machine but found the wire was too brittle to point up. The broken ends had typical "cup and cone" fractures. Samples of both lots of wire were annealed at 275 C for thirty minutes total time in a salt bath and tested for tensile strength and elongation with the following results:

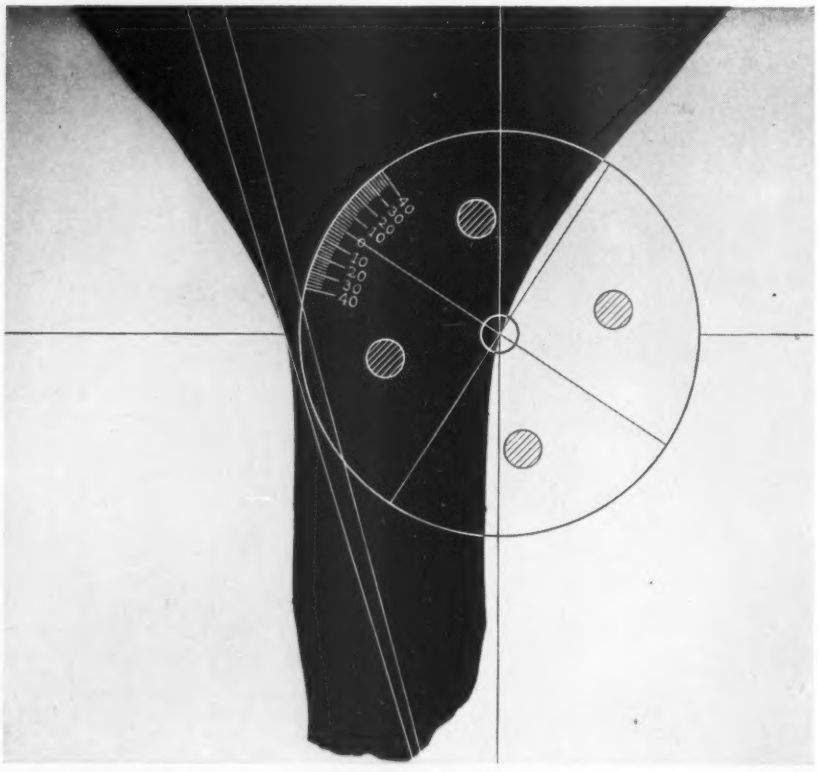

Fig. 5. Magnified profile of a casting, with a superposed representation of scale as viewed through the equipment shown in Fig. 4.

Set No. 1:

Tensile strength 32,500 lb. per sq. in. Elongation in 10 in., 31 per cent.

Set No. 2:

Tensile strength 28,700 lb. per sq. in. Elongation in 10 in., 12 per cent.

The oxygen content of the wire was found to be 0.05 per cent, which is close to normal for tough-pitch copper.

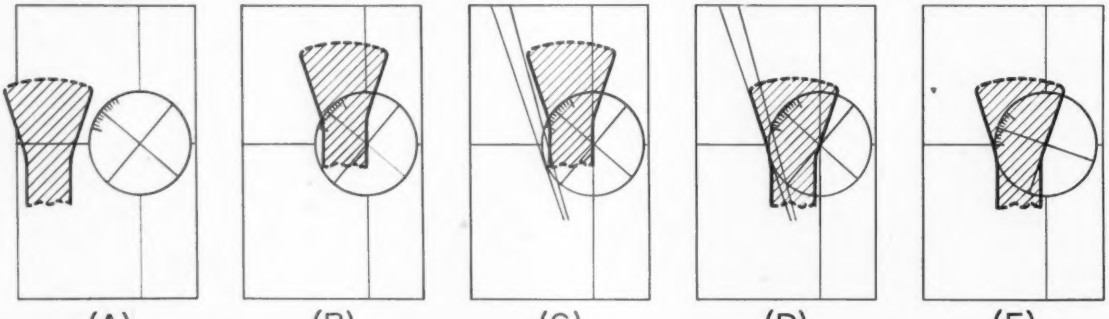

Fig. 6. Steps followed in measuring approach angle

(A): Image of cast in random position on viewing surface.

(B): Image moved to first position so that intercept on horizontal line corresponds to bore of die. The image has also been moved to right, so that the right-hand side passes through the center of the measuring disk.

(C): Image as in (B). A transparent plate has been placed on the viewing surface and moved vertically until the first gauge line crosses the horizontal line at the point of intersection with the left-hand side of the image.

(D): Transparent plate as in (C). The image has now been moved downward and to the left until its intercept with the horizontal line extends from the center of the disk to the second gauge line. The intercept corresponds to the diameter of the wire entering the die.

(E): Transparent plate has been removed and measuring disk turned to tangent position. The approach angle is read directly from the scale on the disk.

Flexible Tubing Made by Patented Wire Knitting Process

UNLIKE other kinds of wire mesh—Knitted Wire is made of rows of resilient loops, which are interlocked with other rows, thus forming a continuous seamless tube. This is accomplished with only one strand of wire. Wire of varying gauges can be used and the tubing can be manufactured in many diameters and in almost any length.

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ONE combination of wire gauge, mesh size and diameter will produce a tube of great flexibility, while another combination will make tubing that has rigidity, and when bent or formed will retain any desired shape or position. Whether a flexible tube or a rigid tube is made, they both possess the same resistance to deformation. The product runs high in tensile, compression and torsional strength.

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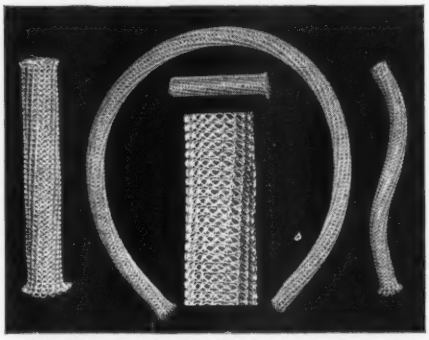
KNITTED Wire can be plated, rust-proofed, enameled or coated just as readily as any other bright steel product. Also, it can be covered with rubber, with silk or any other fabric.

BECAUSE the product has such a unique and unusual appearance, it is a popular item for the decorative and display fields. In this application the tubing is mainly used with bright Chrome and



Nickel finishes. It can be formed into many clever and distinctive designs and, for this reason, it is in demand where the latest mode and uniqueness are desired.

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IT is known that this product possesses a multiplicity of uses and applications in the industrial field. The possibilities for using a flexible armor, such as Knitted Wire, are unlimited. Such an armor can be used as a protective covering for hose or hose connections—for light cords on electric appliances. It is also expected that many different sizes and lengths can be used in assembling various toys—such as dolls, stuffed animals, etc. It provides an effective non-slip grip for tool handles, brooms, brushes, etc. It will doubtless serve as coverings for test tubes and other glass articles. It can be used to provide a wire covering for moving parts in machinery, for flexible shafts or belt drives. There are undoubtedly quite a number of household uses — for instance, small coils can be made up into plate holders, dish drainers, baskets, etc.

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THE important features are:

1—Flexibility or rigidity—whichever is required.
2—High tensile strength and resistance to collapse.
3—Ability to retain required position or shape.
4—High electrical resistance.
5—Easily and efficiently plated or enameled.
6—Low cost per unit.

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THIS is a product of E. H. Titchenor & Co., Binghamton, N. Y., who are working with many industries, providing them with samples of various sizes to test for different applications that suggest themselves.

Model of Hand Operated Fence Machine Invented by Sommer In 1889

FIFTY years ago the Keystone Steel & Wire Company consisted of one clumsy hand-built, hand operated fence weaving machine, housed in a small shed on the farm of Peter Sommer, near Tremont, Illinois.

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ON the occasion of its 50th Anniversary, Keystone has built an actual working model of the machine invented and built by Peter Sommer in 1889, since the original machine was not preserved. The model was reconstructed under the close personal supervision of Mr. W. H. Sommer, President of the Keystone Steel and Wire Co. He is a son of Peter Sommer, and as a boy, worked with his father making Keystone fence on the original machine.

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THE model, built by hand as was the old machine, is as exact a duplicate in material, design and appearance as it was possible to build. It actually makes fence like the original Keystone fabric of 50 years ago.

TWO men were required to operate it, and a third man or boy was often used to roll up the finished fence. Each twist in the wires was made by turning a crank. Going at full production, the machine could make about 10 rods of fence in a long working day.

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BY comparison, one of the large battery of modern Keystone-built fence weaving machines in the Keystone fence mills in Peoria can produce 2500 rods of fence in much less time.

Rod Handling By Overhead Tramrail

A description of the rod handling system by overhead tramrail, installed at the Sparrows Point plant of the Bethlehem Steel Company. This conveying system includes about 2½ miles of overhead track work and is the largest single installation of this type yet completed. ✦ ✦

EFFICIENT handling of rod bundles by an overhead tramrail system is one of the many interesting features in the new continuous rod and bar mill at the Maryland plant of Bethlehem Steel Company. The conveying system, the largest single installation of this type yet completed, includes about 2½ miles of overhead track work.

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FORTY-ONE bins, arranged in three bays joining in a central switching terminal are provided in the storage and shipping building. A depressed standard gauge railroad track runs into one of the bays which serves as shipping bay; the second bay connects the storage with the cleaning and baking department of the wire mill, while the third bay is used exclusively for storage.

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ALL regular bins are 20 ft. wide and 50 ft. long and have five parallel overhead tramrail tracks. They will therefore accommodate five tiers of rod bundles which can be stacked to a height of about 20 ft. above the floor. The center and the two outside rows of bundles rest directly on the floor of the bin, while the two remaining rows rest on timbers laid on a raised concrete structure. This staggered arrangement of the bundles makes them easily accessible, and provides better and neater storage.

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FOUR of the bins in the shipping bay, at the end adjoining the switching terminal, are shorter than the regular bins, only 25 ft. long, instead of 50 ft. In the storage bay one row of four bins has only three overhead tracks and is made narrower than the rest, accommodating three rows of bundles only, instead of five. All other bins are of the regular size, and hold about 300 tons of rod apiece. This gives a total storage capacity of over 11,000 tons. The bins are formed from heavy structural members which are covered with boards on the inner surface to protect the bundles.

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SIX carriers with attached operating cab and hairpin hooks are available; normally five are in regular use, the sixth serving as a spare. Each carrier is equipped with six reversible motors, four 1 hp. motors for traveling and two 7½ hp. motors for hoisting. This makes a total connected load of 19 hp. for each cab. A unit is capable of carrying 5,000 lbs.; eight to ten rod bundles is the maximum capacity of the carrier hooks. Total weight of the unit, exclusive of the load, is only 4,500 lbs. For comparison, a crane with 100 ft. span would weigh 160,000 lbs. Four such cranes would be required to do the same work as the five carriers.

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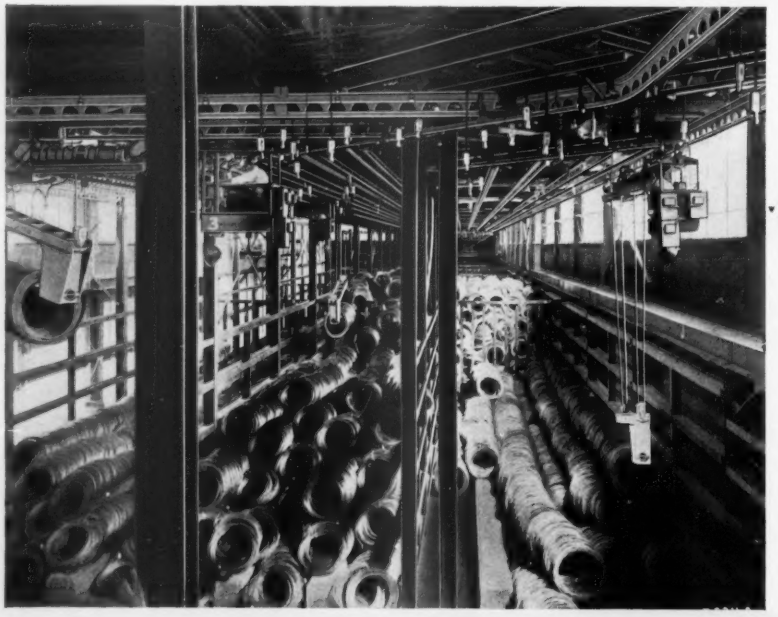
THE carriers run on a special built-up track consisting of an upper section of standard structural steel welded to a lower section with flat running tread made of high carbon steel. Maximum traveling speed is 600 ft. per min., max. hoisting speed 65 feet per minute. Switches are located in all tracks at both ends of all bins, a total of 98 switches in the system. To change from one track to another the carriers must therefore always return to the end of the bins. The switches are



equipped with signal lights and are operated from the cabs.

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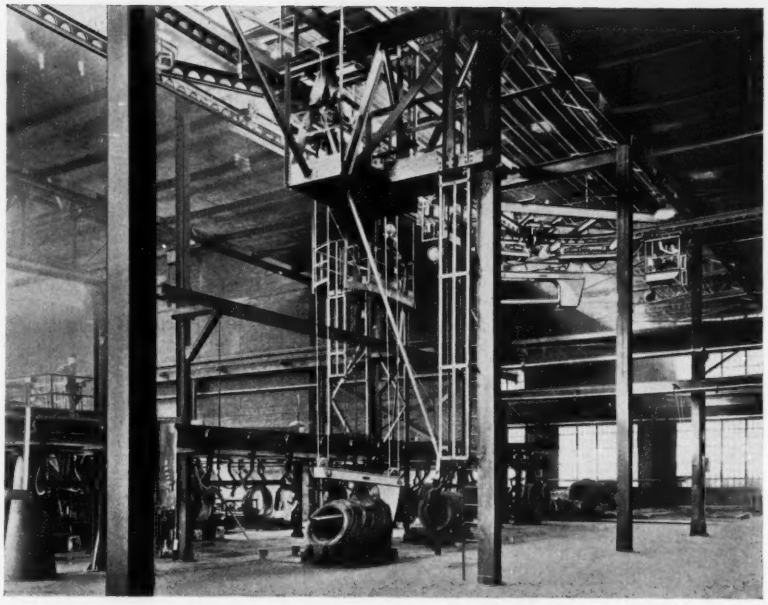

THE finished rod bundles are discharged from the rod mill reels to an open top chain type conveyor, 330 ft. long. From this conveyor the bundles are transferred automatically to a 560 ft. long, double hook carrier which runs to the switching terminal in the shipping and storage bay. During this transport the bundles cool sufficiently to allow inspection, trimming and tying. The bundles are then removed from the carrier by air operated lifting hooks, and placed in a special accumulating cradle. When a load of eight to ten bundles has been assembled the cab operator lowers the hairpin hook, inserts it into the bundles, hoists the load up to attain sufficient clearance, and carries it to storage, shipping platform, or cleaning division, according to instructions on a board within clear view. On the way the load first passes over one of three automatic track scales, with printing device and push button control operated from the cab. No ground operator is required at any stage during loading or unloading in any of the bays.

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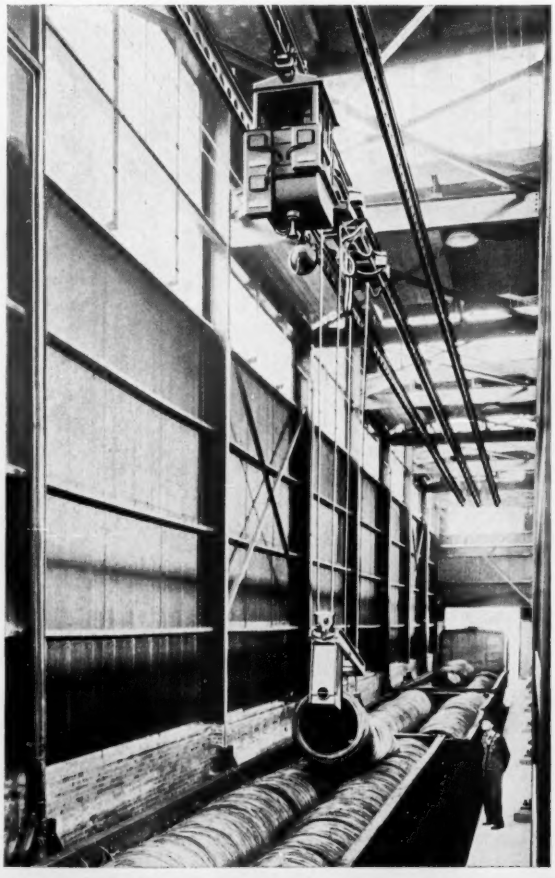
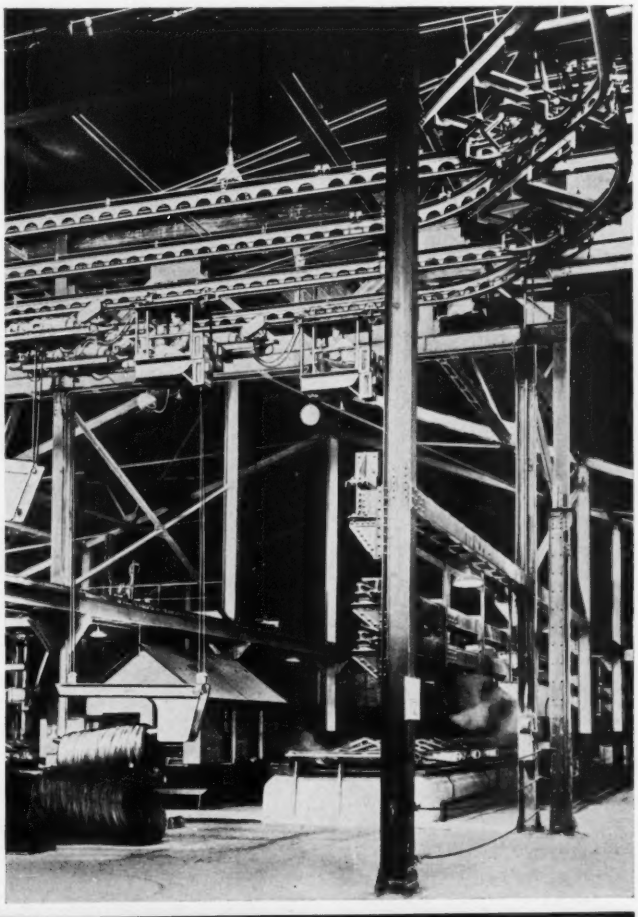
THE tramrail system which was installed in connection with

(*Please turn to page 235*)





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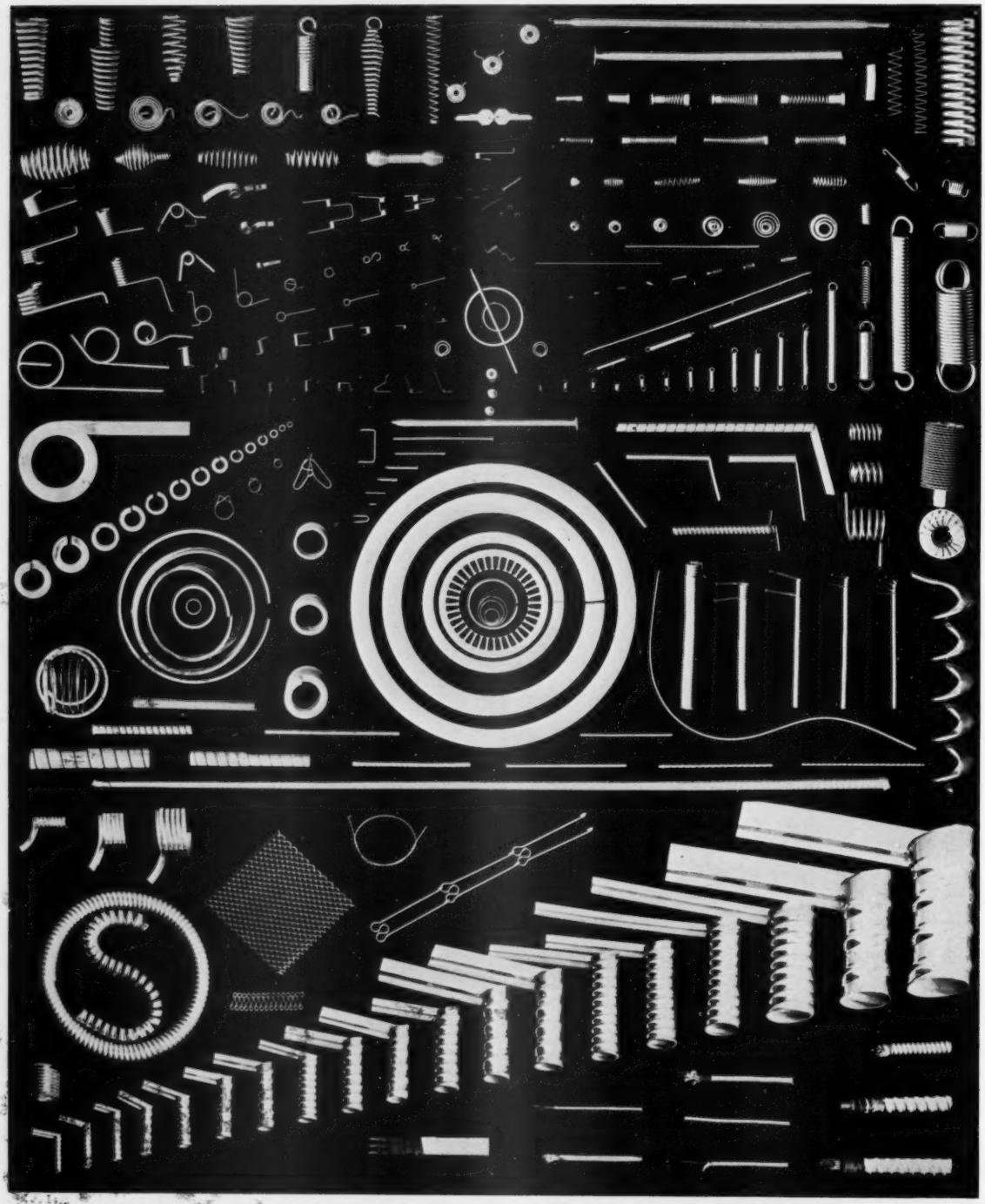

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Deflection of Helical Springs Under Transverse Loadings

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ABSTRACT

This paper presents an analytical approach to the problem of the transverse deflection of a helical closely-coiled spring under the action of a force perpendicular to its axis and an end moment. Supporting test data are included to substantiate the formulas within established limits. Expressions for the stresses under this loading in combination with an axial force are derived for the critical points on the spring. ✦ ✦ ✦

THE use of helical closely coiled spring suspensions for vibrating masses has not only necessitated a careful consideration of the characteristics of the spring under normal axial loading but in addition, where a thrust acts in a direction perpendicular to the axis of the helix, equal regard should be given to the properties of the coil under transverse loadings. This condition is evident in the case of those reciprocating mechanisms where an unbalanced force lies in the horizontal plane; also, it exists in certain types of vehicular suspensions in which a helical spring is utilized to take lateral or fore-and-aft reactions in addition to gravity loadings. The latter application is best exemplified in certain recently constructed types of railway-car trucks incorporating this particular capacity of a helical spring to cushion loads in more than one plane.

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IT is the authors' intention to present herein an analytical approach to the problem of a helical spring with one end resting on a rigid foundation and the other subjected to a transverse loading alone or in combination with an end moment. The investigation includes a derivation of the relationship for the resulting transverse deflection at the free end and attendant stresses under such a condition. Comparison will be made with actual test results made with a wide variety of spring sizes and loadings to demonstrate the validity of the expression for deflection and establish the approximate range of application. The stress derivations are dependent on the ability of the stock itself to follow **Hooke's** law of proportionality for a material in bending and torsion, with appropriate factors for stress concentration due to curvature and may be accepted with no more reservations than are accorded the present approved method of investigation for the axial loading condition.

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THE only specific information available on this subject which the authors were able to find was a paper by **Marty.**[4] In this case, the investigation was mainly concerned with a uniformly distri-

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Note: Statements and opinions advanced in papers are to be understood as individual expressions of their authors, and not those of the Society.

[4] **"On the Calculation of Helical Springs Loaded Transversely" (French), by R. Marty, Comptes Rendus, vol. 192, July 11, 1932, p. 105.**

[5] **"Theory of Elastic Stability," by S. Timoshenko, McGraw-Hill Book Company, New York, N. Y., 1936, pp. 165-167.**

buted transverse load over the length of the spring as occurs under centrifugal loading. This author expressed an effective flexural and torsional rigidity of a helical spring analogous to a beam as a function of certain of its dimensions, and stated the relationship for stress and deflection but without derivations or supporting test data. **Timoshenko**[5] has evaluated the equivalent column characteristics of a helical spring as an axially loaded member for purposes of determining its stability.

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Nomenclature

THE nomenclature used in this paper is as follows:

h = height of helix
ϕ = slope of end coil
D = diameter of helix
R = radius of helix
d = bar diameter
P = axial loading
L = transverse loading
M_0 = end moment on coil
n = effective number of coils = $\left(\frac{\text{solid spring height}}{d} - 1\right)$
f = pitch of helix = (h/n)
θ = angular coordinate of any point on the helix
M_t = torsional moment on any cross section of the bar
J = polar moment of inertia of this section
τ_t = shear stress on this section due to M_t
M_x = bending moment on this section about the axis perpendicular to the axis of the helix
I_x = moment of inertia about this axis
σ_x = bending stress on this section due to M_x
M_y = bending moment on this section about the axis parallel to the axis of the helix
I_y = moment of inertia about this axis
σ_y = bending stress on this section due to M_y
S_x = Shear load on this section perpendicular to axis of helix
S_y = shear load on this section parallel to axis of helix
Q = axial load on this section
τ = shear stress
E = modulus of elasticity in tension and compression
G = Modulus of elasticity in torsion
$\triangle$ = vertical deflection of coil
δ = transverse deflection of coil
V = total strain energy
C_v = vertical spring constant
C_{tc} = transverse spring constant

✦ ✦ ✦

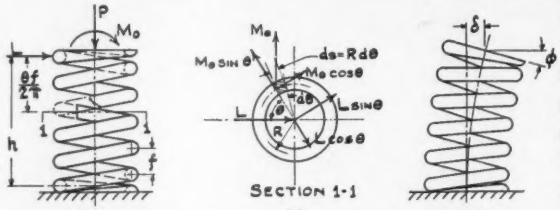

Fig 1. Helical Spring With Initially Parallel End Supported On A Rigid Foundation.

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Deflection

ANY analysis covering the exact deflection of a helical spring necessarily involves consideration of that portion of the deflection introduced by the end coils. Such an analysis introduces complex quantities, and for simplification only that portion of the helix will be considered which involves the full bar diameter.

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CONSIDER a helical spring with initially parallel ends supported on a rigid foundation, as shown in Fig. 1*a*. Assume the helix to extend along the center line of the bar from the first full diameter of the bar on one end to the corresponding point on the other end. This gives a helix height equal to the full distance between coil ends less one bar diameter. Therefore, the number of turns in the helix n will be one less than the solid spring height divided by the bar diameter. Assume the spring to be initially loaded axially with P and consider the effect of superimposing a lateral load L and a moment M_0. Let L intersect the helix axis and lie in a horizontal plane containing the highest point on the helix. Let the transverse end couple M_0 have its vector perpendicular to the plane containing the helix axis and L. Since L is independent of P, only the deflections due to L and M_0 will be considered. The transverse deflection resulting from the application of P will be considered in the Appendix. The helix is developed by the continuous function $R\theta$ and the pitch f. The origin of θ will be taken at its coincidence with L.

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THE general equation for the strain energy[6] is expressed as in Formula [1].

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THIS form of strain-energy equation neglects the effect due to curvature, but is sufficiently accurate for a first approximation.

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IN order to maintain the linear relationships required by the **Castigliano** theorem the influence of the couple $P\delta$ due to deflection is also disregarded. Since the strain energy of direct shear and compression is relatively small, only that portion of the energy equation dealing with bending and torsion will be considered. The slope and deflection may be expressed by

$$V = \frac{1}{2}\int_0^s \left(\frac{M_x^2}{EI_x} + \frac{M_y^2}{EI_y} + \frac{M_t^2}{GJ} + \frac{KS_y^2}{AG} + \frac{KS_x^2}{AG} + \frac{Q^2}{AE}\right)ds \quad \text{[1]}$$

$$\delta = \int_0^s \left(\frac{M_x}{EI_x}\frac{\partial M_x}{\partial L} + \frac{M_y}{EI_y}\frac{\partial M_y}{\partial L} + \frac{M_t}{GJ}\frac{\partial M_t}{\partial L}\right)ds \quad \text{[2]}$$

$$\phi = \int_s^0 \left(\frac{M_x}{EI_x}\frac{\partial M_x}{\partial M_0} + \frac{M_y}{EI_y}\frac{\partial M_y}{\partial M_0} + \frac{M_t}{GJ}\frac{\partial M_t}{\partial M_0}\right)ds \quad \text{[3]}$$

$$\delta = \frac{\partial V}{\partial L} \text{ and } \phi = \frac{\partial V}{\partial M_0}$$

Hence from Equation [1] we have Formula [2] and Formula [3] on page 218.

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FOR closely coiled springs, the pitch angle is small, and with sufficient accuracy, the reaction due to L and M_0 on any section with coordinate θ may be designated as follows:

1. A bending moment M_x in the vertical plane

$$M_x = L\frac{\theta f}{2\pi}\sin\theta + M_0\sin\theta \quad \text{.....[4a]}$$

2. A bending moment M_y in the horizontal plane

$$M_y = LR\sin\theta \quad \text{.....[4b]}$$

3. A torsional moment M_t

$$M_t = L\frac{\theta f}{2\pi}\cos\theta + M_0\cos\theta \quad \text{.....[4c]}$$

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IN addition, there are the following reactions which have been disregarded as influencing deflections:

A direct horizontal shear

$$S_x = L\cos\theta \quad \text{.....[4d]}$$

A direct compressive load

$$Q = L\sin\theta \quad \text{.....[4e]}$$

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THE partial derivatives of Equations [4a], [4b], and [4c] with respect to L and M_0 are

$$\frac{\partial M_x}{\partial L} = \frac{\theta f}{2\pi}\sin\theta; \quad \frac{\partial M_y}{\partial L} = R\sin\theta; \quad \frac{\partial M_t}{\partial L} = \frac{\theta f}{2\pi}\cos\theta;$$

$$\frac{\partial M_x}{\partial M_0} = \sin\theta; \quad \frac{\partial M_y}{\partial M_0} = 0; \quad \frac{\partial M_t}{\partial M_0} = \cos\theta$$

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SINCE $ds = Rd\theta$, Equations [2] and [3], with n = number of turns and $s = 2\pi nR$, become

Formula [4]

Formula [5]

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THE integration of Equations [4] and [5] with simplifying approximations, is shown in the appendix.

Hence with $f = (h/n)$ we have Formula [6] and [7].

EXPRESSING M_0 in terms of ϕ and L from Equation [7], and substituting in Equation [6], the deflection is as shown in Formula [8].

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IN the case where the ends of the spring remain parallel after deflection ($\phi = 0$), and noting that from symmetry $M_0 = -Lh/2$, both Equations [6] and [8] become Formula [9].

✦ ✦ ✦

FOR a round bar steel spring with $E = 29{,}500{,}000$ lb. per sq. in., and $G = 11{,}500{,}000$ lb. per sq. in., the general Equations [6] and [8] for the lateral deflection become

$$\delta = \frac{Dn}{10^6 d^4}(0.825h^2L + 1.238M_0h + 0.271D^2L) \quad \text{.....[10]}$$

and

$$\delta = \frac{LDn}{10^6 d^4}(0.271D^2 + 0.206h^2) + \frac{\phi h}{2} \quad \text{.....[11]}$$

and for a spring whose ends remain parallel after deflection

$$\delta = \frac{LDn}{10^6 d^4}(0.271D^2 + 0.206h^2) \quad \text{.....[12]}$$

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THE transverse-deflection formulas are shown with illustrative diagrams in Fig. 2.

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Stresses

THE maximum stresses imposed by the loading described previously will now be discussed. As in the case of the deflections, the small influence of the helix angle has been neglected. The maximum shear stress under axial loading, including **Wahl's**[7] concentration factor, is given by the formula

$$\tau = \frac{16PR}{\pi d^3}\left(\frac{4c-1}{4c-4} + \frac{0.615}{c}\right) \quad \text{.....[13]}$$

where $c = D/d$.

✦ ✦ ✦

[6] **"Strength of Materials," by S. Timoshenko, D. Van Nostrand Co., Inc., New York, N. Y., 1930, pp. 318-336.**

[7] **"Stresses in Heavy Closely Coiled Helical Springs," by A. M. Wahl, Trans. A.S.M.E., vol. 51, 1929, paper APM-51-17, pp. 185-200.**

✦ ✦ ✦

$$\delta = \int_0^{2\pi n}\left(\frac{Lf^2}{4\pi^2 EI_x}\theta^2\sin^2\theta + \frac{M_0 f}{2\pi EI_x}\theta\sin^2\theta + \frac{LR^2}{EI_y}\sin^2\theta + \frac{Lf^2}{4\pi^2 GJ}\theta^2\cos^2\theta + \frac{M_0 f}{2\pi GJ}\theta\cos^2\theta\right) Rd\theta \quad \text{.....[4]}$$

$$\phi = \int_0^{2\pi n}\left(\frac{Lf}{2\pi EI_x}\theta\sin^2\theta + \frac{M_0}{EI_x}\sin^2\theta + \frac{Lf}{2\pi GJ}\theta\cos^2\theta + \frac{M_0}{GJ}\cos^2\theta\right)Rd\theta \quad \text{.....[5]}$$

$$\delta = Rh\pi n\left(\frac{Lh}{3} + \frac{M_0}{2}\right)\left(\frac{1}{EI_x} + \frac{1}{GJ}\right) + \frac{LR^3\pi n}{EI_y} \quad \text{.....[6]}$$

$$\phi = R\pi n\left(\frac{Lh}{2} + M_0\right)\left(\frac{1}{EI_x} + \frac{1}{GJ}\right) \quad \text{.....[7]}$$

$$\delta = \frac{LRh^2\pi n}{12}\left(\frac{1}{GJ} + \frac{1}{EI_x}\right) + \frac{LR^3\pi n}{EI_y} + \frac{\phi h}{2} \quad \text{.....[8]}$$

$$\delta = \frac{LRh^2\pi n}{12}\left(\frac{1}{GJ} + \frac{1}{EI_x}\right) + \frac{LR^3\pi n}{EI_y} \quad \text{.....[9]}$$

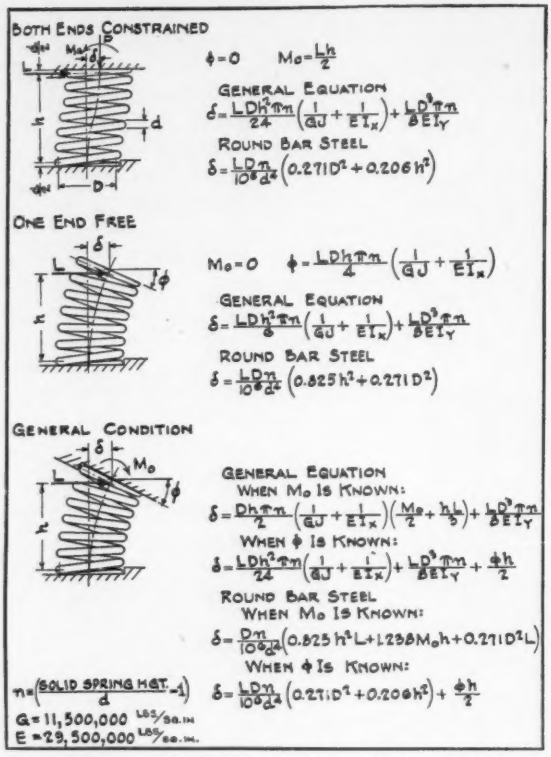
BOTH ENDS CONSTRAINED
$\phi = 0 \quad M_0 = \frac{Lh}{2}$
GENERAL EQUATION
$\delta = \frac{LDh^2\pi n}{24}\left(\frac{1}{GJ} + \frac{1}{EI_x}\right) + \frac{LD^3\pi n}{8EI_y}$
ROUND BAR STEEL
$\delta = \frac{LDn}{10^6 d^4}\left(0.271D^2 + 0.206h^2\right)$
ONE END FREE
$M_0 = 0 \quad \phi = \frac{LDh\pi n}{4}\left(\frac{1}{GJ} + \frac{1}{EI_x}\right)$
GENERAL EQUATION
$\delta = \frac{LDh^2\pi n}{8}\left(\frac{1}{GJ} + \frac{1}{EI_x}\right) + \frac{LD^3\pi n}{8EI_y}$
ROUND BAR STEEL
$\delta = \frac{LDn}{10^6 d^4}\left(0.825h^2 + 0.271D^2\right)$
GENERAL CONDITION
GENERAL EQUATION
WHEN M_0 IS KNOWN:
$\delta = \frac{Dh\pi n}{2}\left(\frac{1}{GJ} + \frac{1}{EI_x}\right)\left(\frac{M_0}{2} + \frac{hL}{8}\right) + \frac{LD^3\pi n}{8EI_y}$
WHEN ϕ IS KNOWN:
$\delta = \frac{LDh^2\pi n}{24}\left(\frac{1}{GJ} + \frac{1}{EI_x}\right) + \frac{LD^3\pi n}{8EI_y} + \frac{\phi h}{2}$
ROUND BAR STEEL
WHEN M_0 IS KNOWN:
$\delta = \frac{Dn}{10^6 d^4}\left(0.825h^2L + 1.238M_0h + 0.271D^2L\right)$
WHEN ϕ IS KNOWN:
$\delta = \frac{LDn}{10^6 d^4}\left(0.271D^2 + 0.206h^2\right) + \frac{\phi h}{2}$
$n = \left(\frac{\text{SOLID SPRING HGT.}}{d} - 1\right)$
G = 11,500,000 LBS/SQ. IN.
E = 29,500,000 LBS/SQ. IN.

Fig. 2. Transverse-Deflection Formulas For Closely Coiled Helical Springs.

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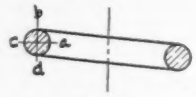

FIG. 3

THIS stress occurs on the inside of the coil as shown at a in Fig. 3, and is constant for all values of θ. The portion $\frac{16PR}{\pi d^3}\left(\frac{0.615}{c}\right)$ is due to direct shear P and will not be affected by the transverse loading. The remainder, $\frac{16PR}{\pi d^3}\left(\frac{4c-1}{4c-4}\right)$ is due to the torque PR and will be increased by any augment in the torque due to L and M_0. The expression for torque, that is Equation [4c], with the addition of PR is

$$M_t = \left(\frac{L\theta f}{2\pi} + M_0\right)\cos\theta + PR \qquad [14]$$

It is obviously a maximum when the expression $[(L\theta f/2\pi) + M_0]$ is a maximum and $\cos\theta = \pm 1$. Also $[(L\theta f/2\pi + M_0]$ will be maximum when θ is either 0 or a maximum, depending on the relative values and signs of L and M_0.

THUS the maximum shear stress will occur on the inside of the coil in the plane containing L and P, shown in Fig. 1. Its magnitude will be as shown in Formula [15] below.

✦ ✦ ✦

DISREGARDING the direct horizontal shear and compressive load due to L given by Equations [4d] and [4e], there remain the bending stresses due to M_x and M_y. An examination of the expressions for these moments shows every term to contain $\sin\theta$ and they are accordingly zero for the points already investigated. The moments M_x and M_y attain their maximum values when $\sin\theta = \pm 1$, i.e., at that section of the coil intersected by a plane which includes the axis of the helix and lies at right angles to (the direction of) L.

✦ ✦ ✦

THUS, $M_x = [(L\theta f/2\pi) + M_0]\sin\theta$ and reaches a maximum value a quarter turn from the maximum for M_t. The moment $M_y = LR\sin\theta$ and is likewise a maximum twice every turn. Where M_x and M_y are maximum, M_t has the value of PR.

✦ ✦ ✦

THE maximum stress due to M_x occurs at the extreme fibers of the bar section at points b and d shown in Fig. 3. At these points the torsional and bending stresses are not increased by any stress concentration.

✦ ✦ ✦

THEREFORE, at b the stresses will be

$$\tau_t = \frac{16PR}{\pi d^3} \qquad [16]$$

$$\sigma_x = \frac{32[(L\theta f/2\pi) + M_0]}{\pi d^3} \qquad [17]$$

The maximum principal stress is shown in Formula [18] and the maximum shear stress is shown in Formula [19].

✦ ✦ ✦

THE maximum stress due to M_y occurs at the inside of the bar at a shown in Fig. 3, where it combines with a torsional shear.

✦ ✦ ✦

AT a, the stresses will be

$$\tau = \frac{16PRk}{\pi d^3} \qquad [20]$$

where $k = \left(\frac{4c-1}{4c-4} + \frac{0.615}{c}\right)$,

and

$$\sigma_y = \frac{32LRq}{\pi d^3} \qquad [21]$$

✦ ✦ ✦

$$\tau = \left[\left(\frac{L\theta f}{2\pi} + M_0\right)_{max} + PR\right]\frac{16}{\pi d^3}\left(\frac{4c-1}{4c-4}\right) + \frac{16PR}{\pi d^3}\left(\frac{0.615}{c}\right) \qquad [15]$$

$$\sigma_{max} = \frac{16}{\pi d^3}\left[\left(\frac{L\theta f}{2\pi} + M_0\right) + \sqrt{(PR)^2 + \left(\frac{L\theta f}{2\pi} + M_0\right)^2}\right] \qquad [18]$$

$$\tau_{max} = \frac{16}{\pi d^3}\sqrt{(PR)^2 + \left(\frac{L\theta f}{2\pi} + M_0\right)^2} \qquad [19]$$

FROM the curved-beam theory, $q = (4c - 1)/(4c - 4)$. The maximum principal stress is shown in Formula [22] and the maximum shear stress

$$\tau_{max} = \frac{16}{\pi d^3}\sqrt{(PRk)^2 + (LRq)^2} \qquad [23]$$

✦ ✦ ✦

IN general it will be found for springs of normal proportions, that the maximum shear stress will be more critical than the maximum direct stress. Therefore, the critical stress will occur on the inside of the coil where M_t is a maximum at which point it will have the value as shown in Formula [15].

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IT will be noted that the maximum moment occurs on the end coil. Obviously, if this coil were tapered, the maximum moment would occur on a reduced section and some provision may be necessary for its protection.

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Discussion of Other Contributing Factors

AS previously mentioned, **Timoshenko**[6] has discussed the stability of helical springs under axial loading. It is obvious that the addition of a transverse load will decrease the axial critical load. A complete investigation and discussion of stability was considered to be beyond the scope of this paper.

✦ ✦ ✦

THE precise equation, including the effect of the helix angle, expressing a relationship for transverse deflection is shown in the Apppendix. Numerical calculations on two springs, whole helix angle was approximately 5 deg., indicated an error of less than 0.5 per cent.

$$\sigma_{max} = \frac{16}{\pi d^3}\left[LRq + \sqrt{(PRk)^2 + (LRq)^2}\right] \qquad [22]$$

$$\tau = \left[\left(\frac{L\theta f}{2\pi} + M_0\right)_{max} + PR\right]\frac{16}{\pi d^3}\left(\frac{4c-1}{4c-4}\right) + \frac{16PR}{\pi d^3}\left(\frac{0.615}{C}\right) \qquad [15]$$

Description of Test Procedure

IN order to demonstrate the validity of the foregoing formulas, tests were conducted on several sets of helical springs to determine the transverse-load-deflection rates. While the original tests were conducted on large springs of the railway type, the procedure was cumbersome due to the magnitude of the vertical loads required. Accordingly, to facilitate experimental work, subsequent tests were conducted on small springs, accurately coiled and with the ends ground. These springs were furnished by the Railway Steel Spring Company.

✦ ✦ ✦

THE pertinent characteristics of all springs tested for lateral deflection properties in conjunction with this paper are shown in Table 1. It will be noted that the experimental springs covered a wide range of ratios of height to diameter, and the spring indexes varied from 4.5 to 6. The experimental apparatus was essentially the same for both the large and small coils, employing in each case four identical helical springs with ground ends seated at the four corners of a rectangular base plate and surmounted by a similar plate on which the vertical load was placed. The assembled coils

TABLE 1—CHARACTERISTICS OF SPRINGS TESTED

Spring no.	Mean diameter D in.	Bar diameter (d) in.	Free height, in.	Solid height, in.	Axial capacity, lb.	$\frac{D}{d}$
1	5.812	1.25	9.219	6.594	10200	4.65
2	3.672	0.734	9.406	6.156	3700	5.00
3	6.726	1.241	15.250	8.72	12200	5.43
4	3.875	0.750	14.656	8.81	4050	5.16
5	0.566	0.123	0.798	0.553	139	4.60
6	0.569	0.123	1.211	0.841	121	4.63
7	0.572	0.123	1.664	1.108	121	4.65
8	0.752	0.123	1.313	0.715	98	6.12
9	0.752	0.123	2.078	1.102	98	6.12
10	0.752	0.123	2.801	1.455	96	6.12

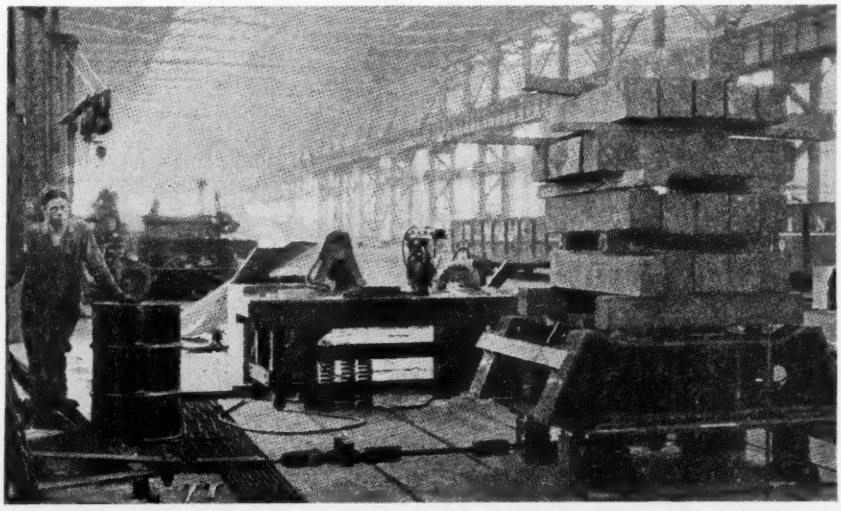

Fig. 4. Apparatus Used For Testing High-Capacity Springs. ✦ ✦ ✦ ✦

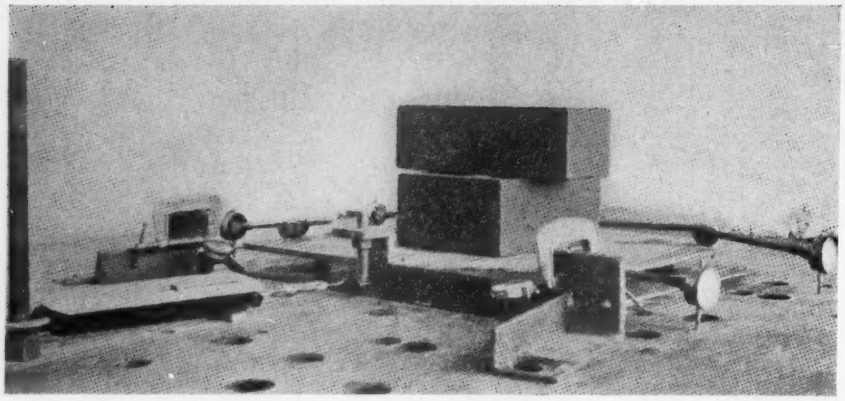

Fig. 5. Apparatus For Testing Small Springs.

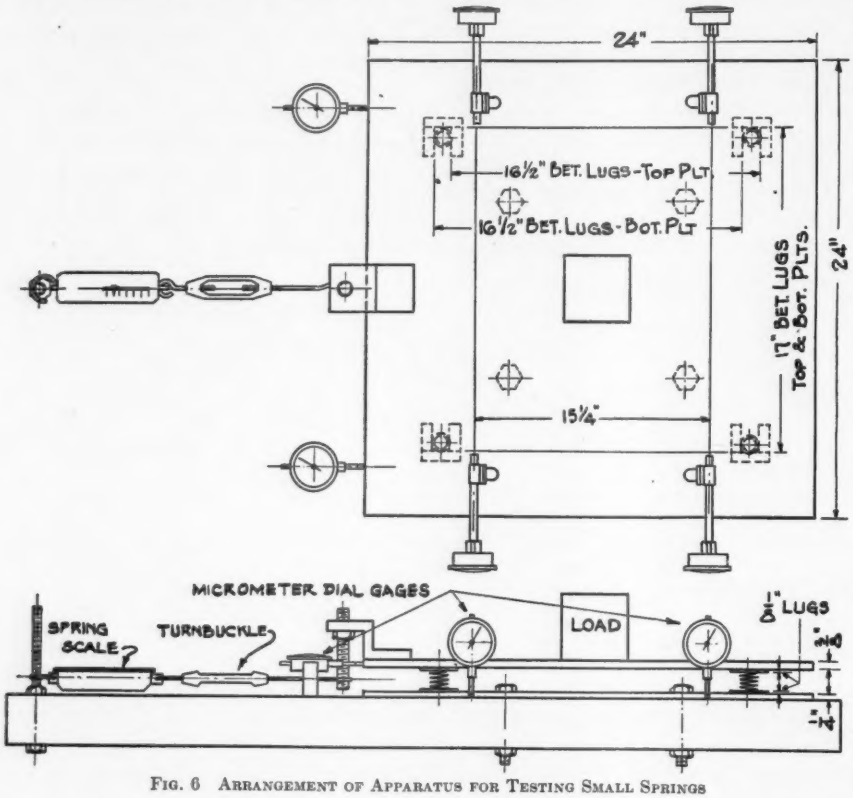

Fig. 6 Arrangement of Apparatus for Testing Small Springs

were then loaded transversely by a turnbuckle and tension rod in series with a load-measuring device lying in a horizontal plane and affixed, one end to a rigid foundation and the other to some point on the top plate according to whether pure translation or combined translation and rotation was to be applied to the top plate.

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IN the case of the large testing apparatus, which is shown in Fig. 4 the springs were retained at both extremities by set bolts tapped in an annular ring welded to each plate around the spring seat and abutting the end coil at the quarter-circle points. A slotted lug was provided at the midpoint of the underside of the top plate, which afforded an opportunity for varying the height of transverse-load application.

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AS shown in Figs. 5 and 6, the small springs were retained in their position by cleats of the same thickness as the bar diameter of the spring; the cleats were welded to the plates on such a side of the coil as to prevent horizontal movement of the ends under transverse loading. An auxiliary cleat was welded at right angles to this, thus forming an angle which thereby nested the end coil on two points of its circumference. An adjustable threaded rod affixed to the front edge of the top plate, in this case, provided a means of varying the height of transverse load application.

✦ ✦ ✦

ON both apparatus the amount of transverse load was determined by mounting a calibrated ring gage or accurate spring scale, according to the magnitude of the loads, in tandem with the turnbuckle. Micrometer dials or, wherever necessary, surface gages, were used to observe all necessary deflections. Lateral deflections were taken on either side of the center line of the top plate to insure an average value of this reading, while vertical deflections were taken at the four corners of the assembly to determine the change in spring heights between the front and rear sets of springs under rotational loading.

✦ ✦ ✦

ALL springs were tested for transverse deflections under gravity loadings of about 25, 50, and 75 per cent of their axial capacity, except in those few cases where the instability of the coil prevented it. Springs Nos. 1, 2, and 3 were transversely loaded at the level of the top plate. It was then recognized that the slope ϕ contributed an appreciable increment to the deflection. Therefore, springs Nos. 4 to 10, inclusive, were loaded at the height of the point of contraflexure of the springs for the purpose of eliminating the end slope. Sufficient increments of transverse load were applied to establish the true rate of transverse deflection, although for obvious reasons the loading was not pursued to the point of instability of the spring. Upon release of the lateral load, no appreciable lag was observed.

Discussion of Test Results

EXAMINATION of the results, as shown in Table 2, indicates good agreement between the actual and the calculated values for a majority of the springs tested. However, a discrepancy exists in the case of certain springs. The approximations occurring in the formula are discussed elsewhere in this paper, together with their effect on the exact evaluation of δ. It will suffice at this point to consider wherein the actual conditions of testing depart from the original assumptions, and to what degree they influence the results obtained.

✦ ✦ ✦

IN order to simulate the general method of a helical-spring installation involving no rigid attachment of the end coils to their base, the testing arrangement made no provision for a constraining moment other than that offered by the loaded plate. In addition, the transverse loading was applied at whatever point of tangency happened to be established between the end coil and the restraining cleat (or set bolt). This procedure, while duplicating practical application, upset certain premises on which the theory was established.

✦ ✦ ✦

(a) The end moment M_0 acted not only upon that portion of the spring contained in the helix proper, but also over the diminishing section of the tapered end coil, thus producing a finite deflection for this portion of the spring which was disregarded in the general equation.

✦ ✦ ✦

(b) Likewise, the transverse loading L, unless the spring possessed exactly n plus ½ coils (where n is a whole number) acted at a point within the tapered region of the end coil, and thereby added its component of transverse deflection in excess of the calculated value.

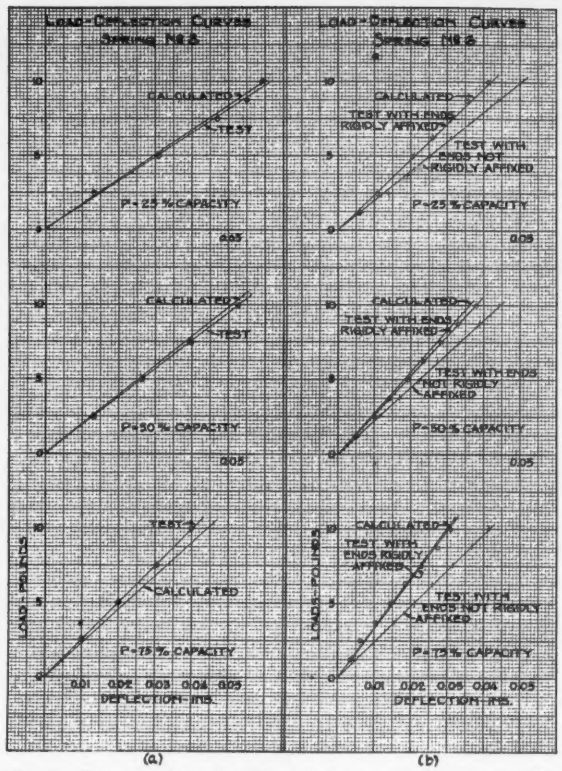

Fig. 7. Transverse-Deflection Characteristics of Two Representative Springs.

✦ ✦ ✦ ✦ ✦ ✦

THE magnitude of the error in the calculated value as the axial loading progressed from 25 to 75 per cent capacity was increased or decreased according to which of two effects was prevalent. (1) When the spring was well within the limits of stability under load, the decrease in M_0 as the working height diminished meant a corresponding decrease in its distorting effect on the end coil as just described in paragraph (a). (2) If the spring approached an unstable condition as the gravity load increased, a given transverse loading produced a greater deflection than would occur for the same transverse loading in combination with a smaller axial-load application.

✦ ✦ ✦

THE actual transverse-deflection characteristics of a representative spring (i.e., spring No. 8) are shown in Fig. 7a with the calculated curve for the extent of the test. Similar characteristics for spring No. 6 are shown in Fig. 7b. This latter spring was subsequently affixed rigidly to steel base plates at its extreme coil faces and almost perfect agreement with the calculated values was obtained. Examination of the actual plotted points in Figs. 7a and 7b indicates that there is no measurable deviation from the straight line. This apparently indicates that the

TABLE 2—COMPARISON OF ACTUAL AND CALCULATED TRANSVERSE DEFLECTIONS

Spring No.	25 per cent axial capacity			50 per cent axial capacity			75 per cent axial capacity		
	Working height, in.	Actual δ/L, in. per lb.	Calculated δ/L, in. per lb.	Working height, in.	Actual δ/L, in. per lb.	Calculated δ/L, in. per lb.	Working height, in.	Actual δ/L, in. per lb.	Calculated δ/L, in. per lb.
1	7.301	0.00028	0.000214	6.679	0.000213	0.000196	6.039	0.00018	0.000176
2	7.860	0.00175	0.001560	7.047	0.001570	0.001310	6.234	0.00145	0.00111
3	12.384	0.00118	0.000827	10.760	0.001000	0.000704	9.141	0.00088	0.000562
4	13.076	0.01610	0.005650	....	Unstable	.....	....	Unstable	.....
5	0.612	0.00162	0.001425	0.554	0.001340	0.001305	0.512	0.00117	0.001227
6	0.934	0.00495	0.004160	0.884	0.004350	0.003600	0.764	0.00415	0.003020
7	1.378	0.01480	0.009550	1.226	0.014800	0.007960	1.143	0.01540	0.007160
8	1.048	0.00615	0.006000	0.902	0.005250	0.005080	0.771	0.00400	0.004370
9	1.720	0.03150	0.020000	1.480	0.026700	0.015870	1.262	0.02450	0.012630
10	2.347	0.11200	0.045700	....	Unstable	.....	....	Unstable	.....

omission of the influence of the couple $P\delta$ is justified.

✦ ✦ ✦

Conclusions

A PLOT of the ratio of actual to calculated deflection versus the ratio of working height to the mean diameter D, on the basis of the actual tests, is shown in Fig. 8.

✦ ✦ ✦

AS previously noted, the springs were chosen to give a wide variation of the latter ratio in order to establish the range of application of these formulas. It appears from the results of these tests that the equations may be used with reasonable accuracy when this ratio is less than 1.5. For the majority of engineering applications of compression springs subjected to transverse loadings, this ratio will not be exceeded. With springs in excess of this ratio there is the possible danger of approaching the limit of stability.

✦ ✦ ✦

THE extent to which the instability and end-coil conditions weaken the validity of the expressions, can only be qualitatively appraised at this time.

✦ ✦ ✦

SINCE the scope of this paper was to establish the expression for lateral deflection within the stable limits and did not consider the influence of the end coil, it is hoped that this research effort will furnish the impetus for further investigation into the subject.

✦ ✦ ✦

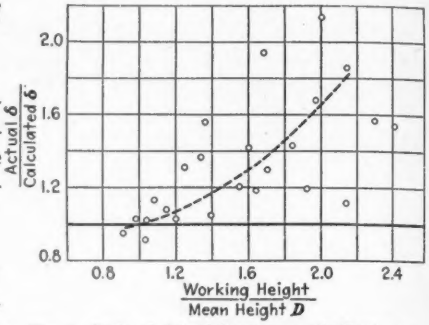

Fig. 8. Ratio of Actual Transverse—Deflection to Calculated Transverse—Deflection Versus the Ratio of Working Height to Mean Height of Springs. ✦

▲▲▲ ▲▲▲

Appendix

THE integrals involved in Equations [4] and [5] are as given in [24*a*], [24*b*], [24*c*], [24*d*], [24*e*] and [24*f*].

✦ ✦ ✦

IN evaluating the foregoing integrals, only the first terms in the brackets have been retained. It will be seen that the balance of the terms diminish rapidly from the first and the evaluation of their maxima was found to affect the calculated deflection less than 1 per cent with n between 3 and 4. With larger values of n the error decreases.

✦ ✦ ✦

THE foregoing analysis deals only with the deflection and slope, resulting from the application of a lateral force and end couple, to a spring initially loaded with an axial force. It is to be noted that the axial force itself may produce a lateral deflection and slope, and by the reciprocal theorem the lateral force and moment may produce a vertical deflection. The following investigation will disclose this effect.

$$\int_0^{2\pi n} \theta^2 \sin^2 \theta d\theta = \left[\frac{\theta^3}{6} - \frac{\theta^2}{4}\sin 2\theta - \frac{\theta}{4}\cos 2\theta + \frac{1}{8}\sin 2\theta\right]_0^{2\pi n} \approx \frac{4\pi^3 n^3}{3} \quad [24a]$$

$$\int_0^{2\pi n} \theta \sin^2 \theta d\theta = \left[\frac{\theta^2}{4} - \frac{\theta}{4}\sin 2\theta - \frac{1}{8}\cos 2\theta\right]_0^{2\pi n} \approx \pi^2 n^2 \quad [24b]$$

$$\int_0^{2\pi n} \sin^2 \theta d\theta = \left[\frac{\theta}{2} - \frac{1}{4}\sin 2\theta\right]_0^{2\pi n} \approx \pi n \quad [24c]$$

$$\int_0^{2\pi n} \theta^2 \cos^2 \theta d\theta = \left[\frac{\theta^3}{6} + \frac{\theta^2}{4}\sin 2\theta + \frac{\theta}{4}\cos 2\theta - \frac{1}{8}\sin 2\theta\right]_0^{2\pi n} \approx \frac{4\pi^3 n^3}{3} \quad [24d]$$

$$\int_0^{2\pi n} \theta \cos^2 \theta d\theta = \left[\frac{\theta^2}{4} + \frac{\theta}{4}\sin 2\theta + \frac{1}{8}\cos 2\theta\right]_0^{2\pi n} \approx \pi^2 n^2 \quad [24e]$$

$$\int_0^{2\pi n} \cos^2 \theta d\theta = \left[\frac{\theta}{2} + \frac{1}{4}\sin 2\theta\right]_0^{2\pi n} \approx \pi n \quad [24f]$$

REFERRING to Fig. 1, let P, only, act on the spring, and apply a dummy load $L = 0$. The only coupling between the two, neglecting the helix angle, lies in the moment M_t, or

$$M_t = PR + \frac{L\theta f}{2\pi} \cos\theta \quad \text{and}$$

$$\frac{M_t}{L} = \frac{\theta f}{2\pi} \cos\theta$$

Hence

$$\delta_{uc} = \int_0^{2\pi n} \frac{PR^2 f}{2\pi GJ} \theta \cos\theta d\theta$$

$$\delta_{uc} = \frac{PR^2 h}{2\pi GJn}\left[2\pi n \sin 2\pi n + \cos 2\pi n - 1\right] \quad [25]$$

IT will be seen that when n is a whole number the value of the bracket (and hence the deflection) is zero. At other values of n the deflection is expressed as follows:

n = whole number plus: δ_p equals:

¼ turn $\quad \frac{PR^2 h}{GJ}\left(1 - \frac{1}{2\pi n}\right)$

½ turn $\quad -\frac{PR^2 h}{GJ}\left(\frac{1}{\pi n}\right)$

¾ turn $\quad -\frac{PR^2 h}{GJ}\left(1 + \frac{1}{2\pi n}\right)$

✦ ✦ ✦

TO determine the end slope induced by P, the dummy moment $M_0 = 0$ may be applied, from which it will be found that

$$\phi_{uc} = \frac{PR^2}{GJ} \sin 2\pi n \quad \text{.....[26]}$$

✦ ✦ ✦

SIMILARLY the vertical deflection induced by the application of L and M_0 will be found to be as shown in Formula [27] and [28].

$$\triangle_L = \frac{LR^2 h}{2\pi GJn}\left[2\pi n \sin 2\pi n + \cos 2\pi n - 1\right] \quad \text{.....[27]}$$

$$\triangle M_0 = \frac{M_0 R^2}{GJ} \sin 2\pi n \quad \text{.....[28]}$$

✦ ✦ ✦

AN evaluation of these reciprocal relationships involves an end-coil analysis to disclose the total effective number of turns so that the equations of the form ($An \sin Bn$) and ($An \cos Bn$) may be determined accurately. This is also true for a precise evaluation of the sinusoidal terms of Equations [24a] to [24f], inclusive. Such an analysis lies beyond the scope of this paper.

✦ ✦ ✦

IT is sufficient, however, to point out that with multiple-spring suspensions, it is possible to dispose the various coils so that their lateral deflection components may counteract.

✦ ✦ ✦

THE point has been raised regarding the lateral deflection under the action of axial loading, inasmuch as it indicates a field of profitable investigation in its bearing on the stable limits of spring loading.

✦ ✦ ✦

THE derivation of the transverse deflection in the body of the paper disregarded the helix angle. Including the effect of the helix angle [$\alpha = \tan^{-1}(f/\pi d)$ gives the following moments:

$$M_x = L\frac{\theta f}{2\pi} \sin\theta + M_0 \sin\theta$$

$$M_y = \left(L\frac{\theta f}{2\pi} \cos\theta + M_0 \cos\theta\right)\sin\alpha + LR \sin\theta \cos\alpha$$

and

$$M_t = \left(L\frac{\theta f}{2\pi} \cos\theta + M_0 \cos\theta\right)\cos\alpha - LR \sin\theta \sin\alpha$$

Also

$$ds = \frac{Rd\theta}{\cos\alpha}$$

✦ ✦ ✦

BY rewriting Equations [4] and [5] and proceeding as in the previous case, the more exact expression for Equation [9] becomes Formula [29], below, for the deflection of a spring whose ends remain parallel.

✦ ✦ ✦

Acknowledgments

The authors acknowledge the cooperation of the following men:

R. Ebenbach, of the E. G. Budd Manufacturing Company, who assisted in conducting the tests.

E. G. Hallquist, vice-president of General Steel Castings Corporation, who placed the facilities of this plant at the authors' disposal for conducting the tests on the large springs.

E. Schmidt, of the E. G. Budd Manufacturing Company, who made possible the tests on the small springs. The latter were furnished through the kindness of T. R. Weber, Railway Steel Spring Division, American Locomotive Company.

The authors are grateful to R. Eksergian, of the E. G. Budd Manufacturing Company, for his personal assistance and contributions in the preparation of this paper.

$$\delta = \frac{LRh^2\pi n}{12}\left(\frac{\cos\alpha}{GJ} + \frac{1}{EI_x \cos\alpha}\right) + \frac{LR^3\pi n}{EI_y} \cos\alpha - \frac{LR^2 h}{2}\left(\frac{1}{GJ} + \frac{1}{EI_y}\right)\sin\alpha \quad \text{.....[29]}$$

Outstanding Personalities of the Wire Industry

General Cable Corporation Changes

AT the annual meeting of the General Cable Corporation, held March 15, two new Directors were elected: C. E. Yates and Moss A. Kent.

✦ ✦ ✦

AT the Directors' meeting, held on the same date, three new Vice-Presidents were elected:

P. D. Rensenhouse (who was and still is Treasurer)
C. E. Yates (who was and still is Secretary)
Moss A. Kent, formerly in charge of manufacturing operations for the company.

✦ ✦ ✦

TO Mr. Kent particularly we extend our congratulations on his election as Vice-President and the best wishes of the members of the Wire Association, of which organization he is now a Director.

✦ ✦ ✦

Harvey B. Jordan, Vice President Of Operations, American Steel & Wire Co.

HARVEY B. JORDAN has been appointed vice president, American Steel & Wire Co., Cleveland. Mr. Jordan will be in charge of operations, and succeeds M. W. Reed, recently made chief engineer for Carnegie-Illinois Steel Corp., Pittsburgh.

✦ ✦ ✦

MR. JORDAN has been in the employ of the Wire company 25 years, having started as a chemist at Central furnaces and docks in Cleveland during his college vacation period in the summer of 1914. In June, 1915, he was placed permanently with the company, being employed as clean-up foreman at the same plant. He then moved up through the ranks until he was named assistant vice president in January, 1937. He is a member, American Society for Metals, Eastern States Blast Furnace and Coke Oven Association, American Iron and Steel Institute.

MOSS A. KENT
Vice-President and Director of Manufacturing of General Cable Corporation. Chairman, Technical Committee on Magnet Wire Sectional Committee on Specifications for Insulated Wires and Cables. Director of the Wire Association.

Joseph C. Belden

JOSEPH CONGDON BELDEN, President of Belden Manufacturing Company, died February 17 at his home in Chicago. He succumbed to an ailment from which he had been suffering for several months prior to his death.

✦ ✦ ✦

HARVEY B. JORDAN
Vice-President of Operations
American Steel & Wire Company

MR. BELDEN was born in Chicago, June 11, 1873, and was graduated from Sheffield Scientific School, Yale University, in 1897. He then returned to Chicago and was associated with the Kellogg Switchboard and Supply Company until 1902 when he founded the company which bears his name. He remained president of the company until the date of his death, always active in the management of the business which he built and steered from a modest venture to the extensive enterprise it is today.

✦ ✦ ✦

MR. BELDEN was admired and respected by all his associates. He was well known in the electrical industry and was elected President of the Electrical Manufacturers Club in 1929 and 1930. He was a director of the Illinois Manufacturers Association from 1932 to 1937, and Vice-President of that organization 1937-38. He was President of the Employers Association of Chicago from April, 1933 to January, 1938.

✦ ✦ ✦

J. F. Chapple, Republic Assistant District Sales Manager at Houston

THE appointment of J. F. Chapple as assistant district sales manager at Houston for Republic Steel Corporation has been announced.

✦ ✦ ✦

MR. CHAPPLE has spent all of his life in the sales end of the steel industry, starting with the Gulf States Steel Company in 1918. He was employed in both the clerical and selling divisions of Gulf States sales department and remained with the company after its merger with Republic Steel Corporation, serving as salesman in the Birmingham territory.

✦ ✦ ✦

W. A. Huber

THE appointment of **W. A. Huber** as Manager of Sales of the Gilmore Wire Rope Division of the Jones & Laughlin Steel

(*Please turn to Page 229*)

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Jan. 1939 and Jan. 1938
(In gross tons)

	JAN. 1939	DEC. 1938	JAN. 1938
Wire rods	353	307	2,488
Strip steel	7,225	6,807	5,963
Plain, black or galvanized iron or steel wire	4,140	4,607	3,559
Barbed wire and woven wire fencing	2,586	3,318	965
Woven wire screen cloth	143	111	69
Wire rope	242	342	305
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	570	726	502
Wire nails	1,528	2,599	825
Tacks	13	25	10
Other nails, including staples	309	188	145
Bolts, machine screws, nuts, rivets and washers	586	749	700
Total, these 11 classifications	17,695	19,779	15,531

Imports of Iron and Steel Wire Into the United States
(In gross tons)

Concrete Reinforcement Bars	365	317	45
Hollow bar and drill steel	100	48	125
Wire rods	1,196	480	504
Barbed wire	1,012	738	3,242
Round iron and steel wire	285	264	73
Telephone and telegraph wire	1	11	.....
Flat wire and strip steel	270	295	263
Wire rope and strand	240	114	213
Other wire	240	73	259
Hoops and bands	1,894	2,143	2,177
Nails, tacks and staples	553	677	536
Bolts, nuts and rivets	12	5	12
Total, these 12 classifications	6,168	5,165	7,449

Exports of Insulated Wire and Cable, January, 1939

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber covered wire	476,180	$110,859	122,628	$ 28,569
Weatherproof wire	158,379	24,251	87,839	14,665
Other insulated copper wire	342,893	77,123	256,233	45,681
Nickel-chrome electric resistance wire	23,239	19,983	.....	.....
Total, these 4 classifications	1,000,691	$232,216	466,700	$ 88,915

Imports

AT 24,331 tons valued at $1,729,145 imports of iron and steel products (scrap excepted) in January were 2,083 tons and $323,441 greater than in December. In point of tonnage the principal class of products imported was "other" pipe (6,550 tons) — i.e., steel pipe other than welded pipe —including 6,393 tons imported from Germany. Structural shapes with 3,534 tons was second with Belgium supplying 2,923 tons. Of the 3,150 tons of ferromanganese received during the month 1,302 tons came from Norway, 1,098 tons from the Netherlands, and 644 tons from Czecho-Slovakia. Belgium (1,584 tons) was the chief source of the 2,188 tons of "steel bars, whether solid or hollow" as well as of 1,601 tons of the 1,894-ton trade in "other" hoops and bands.

✦ ✦ ✦

GERMANY was the principal source of supply for these products during January—her total of 8,829 tons being featured by the inclusion of 6,393 tons of "other" pipe. Second place went to Belgium with a total of 7,252 tons including 2,923 tons of structural shapes, 1,601 tons of "other" hoops, and 1,584 tons of bars, whether solid or hollow. Sweden's total of 1,792 tons—including 967 tons of wire rods—was the third highest for any country during the subject month.

✦ ✦ ✦

THE 1,374-ton trade with Norway was marked by the importation of 1,302 tons of ferromanganese which product (1,098 tons) was also the leading material in the 1,362-ton trade with the Netherlands. Imports from France—1,322 tons—were fairly diverse with shapes (526 tons) the largest single item. Spiegeleisen—975 tons—was the leading product in the 1,317-ton trade with Canada.

✦ ✦ ✦

IMPORTS of iron and steel products (excepting scrap) totaled 24,331 tons valued at $1,729,145 in January, an increase of 2,082 tons and of $323,441 over December receipts, but more than 5,000 tons under the 29,409-ton, $1,680,955 trade of January 1938.

✦ ✦ ✦

SCRAP imports at 3,333 tons valued at $30,707 were only about half as great as in December (6,519 tons valued at $76,649), but were many times larger than the January 1938 trade of 222 tons valued at $6,632.

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Exports

EXPORTS from the United States of iron and steel products (scrap excluded) totaled 134,788 gross tons and were valued at $10,214,547 in January. In December this trade had amounted to 166,404 tons valued at $11,506,216, while in January 1938 a total of 229,757 tons valued at $14,958,542 had been exported.

✦ ✦ ✦

SCRAP exports were also lower in January — 227,884 tons valued at $3,351,351 as compared with shipments totaling 323,691 tons valued at $4,797,676 in December and of 356,537 tons valued at $6,065,852 in January 1938.

✦ ✦ ✦

DECLINES of 14,297 tons in shipments of pig iron (reducing the January trade to only 6,325 tons), and of 10,175 tons in exports of non-alloy, non-fabricated plates (bringing the total of these shipments down to 9,751 tons) accounted for the major part of the 31,616-ton decline registered by January exports. The month saw gains recorded in the trade in non-alloy ingots, tin plate, and

(*Please turn to Page 228*)

Exports and Imports

(*Continued from Page 227*)

non-alloy black steel sheets, however.

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IN point of tonnage the last named item — non-alloy black steel sheets — was the principal product exported—the 24,268-ton January trade in this item including shipments of 5,452 tons to Russia, 4,749 tons to the United Kingdom, of 4,300 tons to Canada, and of 2,589 tons to Brazil. Japan —11,704 tons—was the month's principal purchaser of ingots, exports of which totaled 13,336 tons. Tin plate as usual enjoyed wide distribution with Brazil, 2,077 tons; the Netherlands, 1,648 tons; Syria, 1,311 tons; and the Philippine Islands, 1,214 tons; the leading takers in this 12,670-ton trade. Exports of non-alloy "other" nonfabricated plate — 9,751 tons — went principally to the Netherlands, 4,310 tons; Canada, 654 tons; and Brazil, 605 tons; while the month's chief buyers of galvanized steel sheets (7,326 tons), included the Philippine Islands, 3,725 tons; Colombia, 753 tons; and Canada, 508 tons.

✦ ✦ ✦

JAPAN was the leading individual market in the January trade—her total of 22,674 tons of iron and steel (other than scrap) including 11,704 tons of non-alloy steel ingots, 6,001 tons of pig iron, and 1,154 tons of non-alloy "other" steel bars. Black steel sheets of non-alloy grade (4,300 tons) featured the 11,521-ton trade with Canada in which was also included 2,325 tons of plain structural shapes, 2,267 tons of hot-rolled strip steel, 1,353 tons of non-alloy "other" steel bars, and 1,068 tons of cold-rolled strip steel.

✦ ✦ ✦

OTHER leading markets in January were Brazil whose 11,609-ton total included 2,642 tons of heavy rails, 2,589 tons of non-alloy black steel sheets, and 2,077 tons of tin plate; the Philippine Islands—10,165 tons—including 3,725 tons of galvanized steel sheets, 1,328 tons of reinforcing bars, and 1,214 tons of tin plate; the Netherlands—7,236 tons—of which 4,310 tons was non-alloy "other" plates and 1,648 tons of tin plate; and the United Kingdom —7,056 tons—of which 4,749 tons was non-alloy black steel sheets and 1,647 tons hot-rolled strip steel.

✦ ✦ ✦

SCRAP exports registered a 29.7 percent decline in January as compared with December. The 227,884-ton trade of the latter month was comprised of 225,434 tons of iron and steel scrap, 857 tons of tin plate scrap, 782 tons of tin plate circles, and 811 tons of waste-waste tin plate.

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The

WORCESTER REGIONAL MEETING

OF THE

WIRE ASSOCIATION

WILL BE HELD AT

Worcester, Mass., Tuesday, April 25, 1939

Wire Association Headquarters Will Be at Hotel Bancroft.

Inspection of Plant of The Norton Company

Interesting Papers and Discussions At Meeting

Make Your Plans Now to Join in This Activity

Outstanding Personalities of the Wire Industry

(*Continued from Page 226*)

Corporation was announced recently.

✦ ✦ ✦

MR. HUBER has been with J & L since 1936 and prior to that time had been in public accounting and sales work for a number of years.

✦ ✦ ✦

C. H. Saiter

C. H. SAITER has been appointed Sales Manager of the heavy Crane Division of The Cleveland Crane and Engineering Company, with headquarters at Wickliffe, Ohio.

✦ ✦ ✦

C. H. SAITER

MR. SAITER was Assistant Chief Engineer of the company for a number of years, having been with the company since 1922. For the last eight years he has been Manager of the Pittsburgh District. For the time being he will continue to actively supervise the Pittsburgh District in addition to his new duties.

✦ ✦ ✦

H. T. FLORENCE, who has been Sales Manager was recently appointed General Manager of the Company.

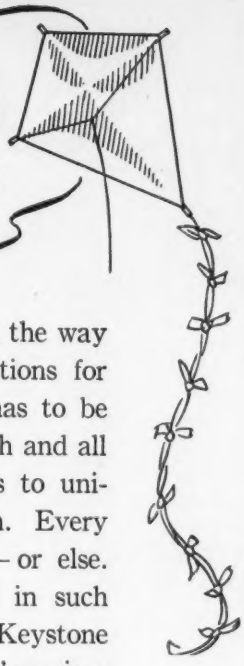
✦ ✦ ✦

Malcolm W. Reed, Chief Engineer, Carnegie-Illinois Steel Corp.

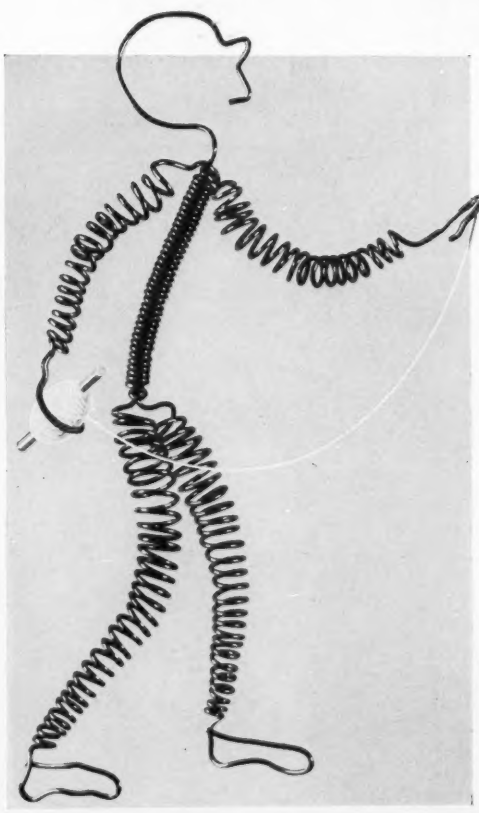
MALCOLM W. REED, heretofore vice president in charge of operations, American Steel & Wire Co., Cleveland, has been appointed chief engineer, Carnegie-

(*Please turn to Page 230*)

SKY HIGH in QUALITY



Those technical men of ours let it out all the way when it comes to drawing up specifications for Keystone wire to suit your needs. It has to be just right in size, analysis, hardness, finish and all the other qualities. And when it comes to uniformity, they're hard to get along with. Every lot must check out 100% in the lab — or else. But we think it pays to be thorough in such things — and so will you, if you give Keystone wire a try. Give us a line, and we'll come a 'running.



HIGH CARBON
or
LOW CARBON

Bright . . . Tinned
Coppered
Annealed
Galvanized

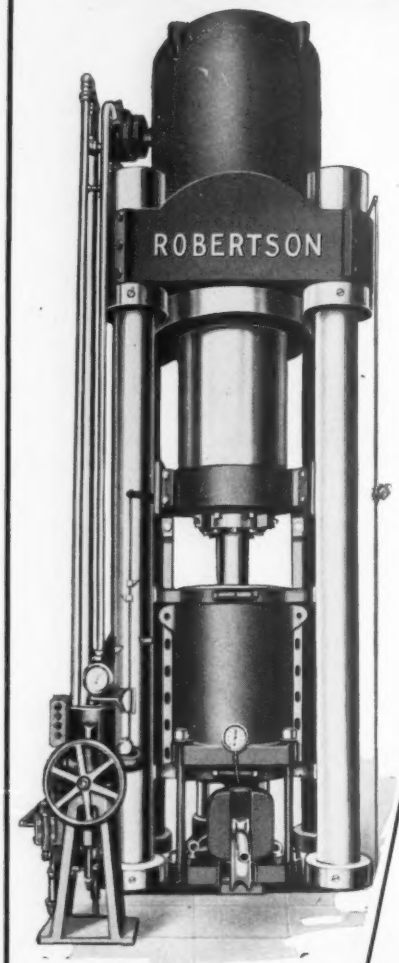
SAMSON
REG. U.S. PAT. OFF.
SPRING WIRE
KEYSTONE STEEL & WIRE CO. PEORIA, ILL.

KEYSTONE

STEEL & WIRE CO., Dept. W, PEORIA, ILL.

Service measured in Decades...

not just years!



Figured on cost per year of active, useful service ROBERTSON CABLE LEAD ENCASING PRESSES are a rock-bottom buy. Built to last and designed "ahead of their time", your Robertson Press will sheath economically thousands upon thousands of miles of lead cable for years to come. You get *more for your money* in operating features, in constructive quality, in production efficiency. Follow the Leaders; choose ROBERTSON!

NEW BULLETIN just released fully describes Robertson Cable Lead Encasing Presses part by part and advantage by advantage. Your copy is free — sent without obligation on request on your letterhead. Write —

Coming to the Fair?
Then, we're extending herewith our most cordial invitation to you to visit our plant—see for yourself the precision and care with which all Robertson products are engineered.
Courtesy New York World's Fair

John ROBERTSON CO. INC.
Pioneers~Since 1858
125-137 Water Street Brooklyn, N. Y.

Outstanding Personalities of the Wire Industry

(*Continued from Page 229*)

Illinois Steel Corp., Pittsburgh. He succeeds Sydney Dillon, who has been transferred to the office of the chief engineer, United States Steel Corp. of Delaware.

✦ ✦ ✦

A GRADUATE of the United States Naval academy in 1916, Mr. Reed joined American Steel & Wire in that year as a wire rope tester at the North works, Worcester, Mass. Two years later he went to the New Haven, Conn., plant, and advanced to the superintendency before going back to Worcester as assistant district manager. In September, 1932, Mr. Reed was transferred to Cleveland as chief engineer; a year later was appointed assistant to the vice president and chief engineer, and in January, 1937, became vice president in charge of operations.

✦ ✦ ✦

L. R. KELLS
Chief Engineer, Salem Eng. Co., Salem, O.

MR. L. R. KELLS has been appointed Chief Engineer for Salem Engineering Company of Salem, Ohio. Mr. Kells graduated from Ohio State University in 1914 and has been intimately associated with the industrial furnace industry for over twenty years.

'Round the World With the Wire Industry

German Notes

THE German wire rod production in 1938 reached 1,448,000 tons, an increase of 200,000 tons over 1937. It is expected to increase production in 1939 to some 1 million tons. The restrictions imposed on purchases of wire rods by domestic consumers have been abolished with two exceptions and buyers can now get wire rods without any limitation. No change of prices is announced for 1939. Prices have now been unchanged since 1931.

✦ ✦ ✦

WIRE machinery is very satisfactorily in demand, orders both from domestic and export markets being very large. Turnovers in 1938 were 20% better than the year before. There was no difficulty in supply of raw materials to the industry, but the improvement in the business was not uniform. Cable machines were in greatest demand, wire rope machinery next, nail making machinery was neglected and barbed wire machinery was in least demand by the end of the year, whereas multiple spindle automatic wire drawing machines were very largely demanded. The works are equipping their plants with the most modern types available at present. Due to the very serious shortage of skilled labour production cannot be further increased. The export trade has been best in all European markets, but Overseas markets were also buying.

✦ ✦ ✦

THE demand for wire rods has been rather satisfactory. The price is well maintained at 4.18 to 5.5£ (gold) and some European markets are even paying 5.6.7. For heavy coils of 3-400 lbs. the demand is now also rising in Europe. A contract has been signed with the United States for 340 tons of such wire rods in hard quality at the basis of 58.-£ (paper) cif. Pacific Port, this business in hard quality rods is exceptional for America. The demand for 5/15" and 3/8" wire rods is declining.

✦ ✦ ✦

CABLE exports have been rising in 1938 with 43,516 tons as compared with 38,820 tons exported in 1937. The main buyer was Holland taking 8,865 tons. The value of exports increased from 22.39 to 24.43 Million Marks. The influx of new orders for cable are also maintained this year, particularly from the Balkan, the Near East, Holland and the Dutch Colonies. It is however to be noted that lead covered cable is disappearing from the export list, whereas steel clad cables are gaining rapidly.

(*Please turn to Page 232*)

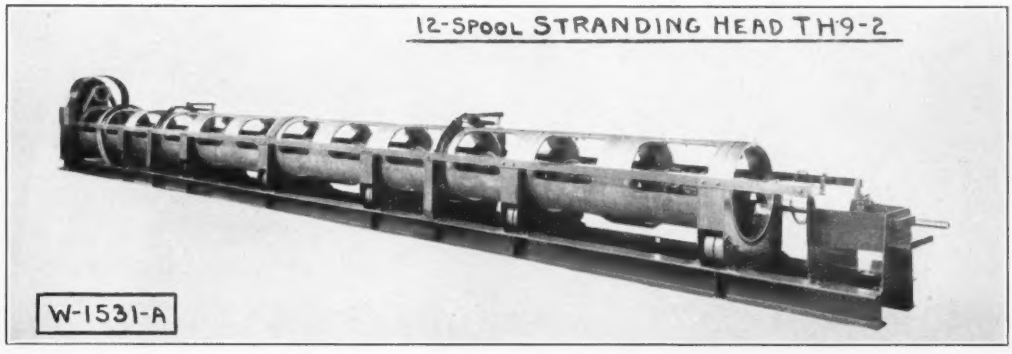
THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

TUBULAR STRANDING MACHINES

Standard Sizes For From 5 to 1000 Pound Spools
Silent Support Rolls—All Steel Rotor—Vee Belt Drive—Electric Stops



ELECTRICAL WIRE, CABLE & WIRE ROPE MACHINERY

Printed Literature Available On Considerable Of The Equipment Used In These Fields—Inquiries Are Invited

'Round the World With the Wire Industry

(*Continued from Page 231*)

IT is interesting to note that there is a growing demand for barbed wire in small packages, of only 5, 7 or 10 lbs. net content (mainly for gardeners) on the exports markets. A few years ago such a packing of barbed wire was still practically unknown, but at present not only European countries (as for instance Ireland, Ulster, Holland, Switzerland, etc.), but more and more Overseas countries are specializing in the purchase of such barbed wire packings.

✦ ✦ ✦

THE demand for sewing and other needles on the export markets is very calm, the business being heavily affected by the impossibility of trading on a large scale with China. The domestic demand is satisfactory but amounts to 40-45% only of the total turnover.

✦ ✦ ✦

ON the domestic market the demand continues very satisfactory, particularly as concerns wire netting, for which there is an "astonishingly great" demand, while the demand for barbed wire has fallen back, as well as for industrial wire mesh. Wire nails are ordered in very large quantities, as also steel wires and all special wire qualities. On the contrary on the export market business is quiet. The February turnovers will differ little from January turnovers. The Near East has stopped buying, and also Latin America buys very little, whereas from South Africa and the African Colonies the demand has slightly improved. Wire netting, including chain link fencing wire is selling best of all products, least in demand is barbed wire after the boom of last year. No important change of prices is noted. Netting is more stable, but wire nails are somewhat affected by outside competition. Wood screws are in good demand on all export markets.

✦ ✦ ✦

Continuous Mill Planned By Steel Co. of Canada

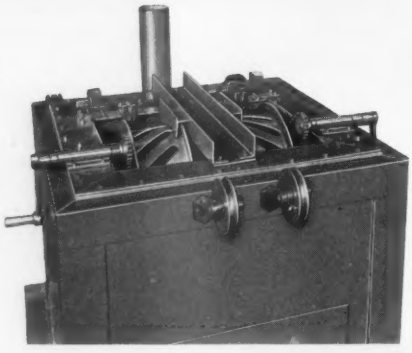
STEEL Co. of Canada, Ltd., Hamilton, Ont., by recent action of stockholders, has authorized directors to raise capital for construction of a continuous strip mill, to cost about $10,000,000, by issuing bonds, debentures or other securities. This will be the first continuous mill in Canada and one of the few outside the United States. One was completed recently for Richard Thomas & Co., Ebbw Vale, England.

✦ ✦ ✦

IN preparation for this development, Steel Co. of Canada in 1937 purchased from United Engineering & Foundry Co., Pittsburgh, a 44-inch blooming mill, a duplicate of the new blooming mill of Republic Steel Corp. at Cleveland.

Syncro Offers . .

Complete Saturating and Finishing Equipment



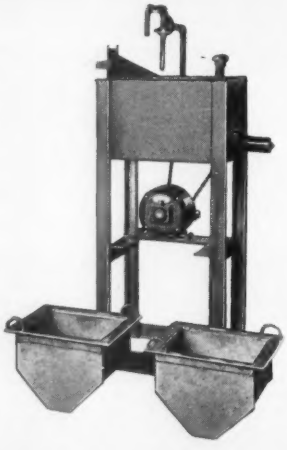
SYNCRO

Syncro products include a complete line of equipment for saturating and finishing wire and cable.

The upper picture shows a top view of a typical gas heated double finishing unit, the center picture illustrates a paraffin applying unit and the bottom picture shows a complete finishing unit.

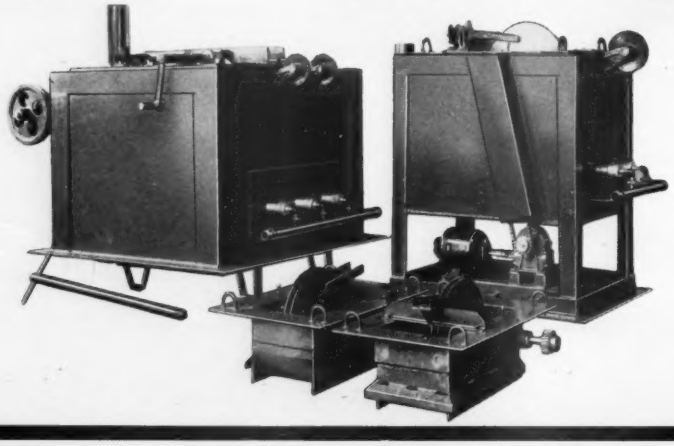
All Syncro saturating and finishing equipment is substantially constructed of welded steel and thoroughly insulated to insure efficient and economical operation.

For complete information, write for bulletin No. 505.



SYNCRO MACHINE CO.

420 Lexington Avenue, New York



A Review of Recent Wire Patents

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

NO. 2,146,035, METHOD AND MACHINE FOR FORMING WIRE HANGERS, Patented February 7, 1939 by Stanley Simmons and Cecil McKeen, Detroit, Mich., assignors to Cleaners Hanger Company, Detroit, Mich., a corporation of Michigan.

In order to correct divergency of the hook forming portion of the wire hanger, the inventor interposes an insert and bends the wire against the insert into parallelism, whereupon the insert is withdrawn.

✦ ✦ ✦

NO. 2,146,275, IMPREGNATED WOVEN SHEATH, Patented February 7, 1939 by Harry E. Thompson, Providence, R. I., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

The outer parts of the textile strands, forming the sheath about the wire conductor, are impregnated with a formaldehyde phenol resin having wear resistant qualities.

✦ ✦ ✦

NO. 2,146,788, WIRE-DRAWING DIE AND METHOD, Patented February 14, 1939 by Harry Blount, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

An object of the invention is to provide a die for drawing cylindrical wire into a strand having a flattened, elliptical or oval cross-section.

✦ ✦ ✦

NO. 2,146,995, WIRE DRAWING DIE, Patented February 14, 1939 by Abraham Simons, New York, N. Y.

A nib and jacket assembly is provided, the adjacent walls of the nib and jacket being correspondingly tapered, the direction of taper being opposite to the wire's movement through the nib.

✦ ✦ ✦

NO. 2,147,065, HIGH SPEED STRANDING OR WIRE ROPE MACHINE, Patented February 14, 1939 by William E. Somerville, Coal City, Ill.

Means is provided to prevent the wires from twisting about each other until they reach the die.

✦ ✦ ✦

NO. 2,147,118, WIRE ROPE CENTER, Patented February 14, 1939 by Frank H. Ellsworth and Charles W. Walker, Worcester, Mass., assignors to The American Steel and Wire Company of New Jersey, a corporation of N. J.

Centers are provided comprising animal fibers, which, it is claimed, resist charring by acids much more than do vegetable fibers.

✦ ✦ ✦

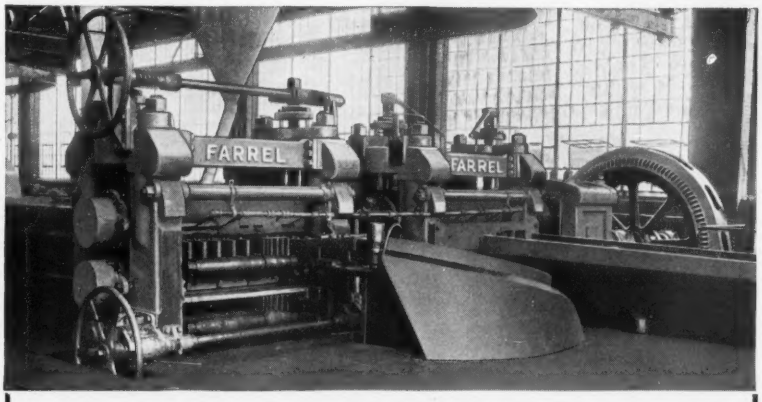
NO. 2,147,328, WIRE FABRIC AND METHOD OF MAKING THE SAME, Patented February 14, 1939 by Otto Carl Scherfel, Haddon Heights, N. J., assignor to Audubon Wire Cloth Corporation, Philadelphia, Pa., a corporation of N. J.

The fabric comprises groups of helically coiled wires in nested relation, with wires of right-hand twist alternating with wires of left-hand twist, and cross rods extending longitudinally of the helically coiled wires; the alternate cross rods being engaged by helically coiled wires of different twist and each of the helically coiled wires accommodating a plurality of cross rods other than those directly engaged by the bights of their helices.

NO. 2,147,337, ELECTRIC CABLE, Patented February 14, 1939 by Harry Charmoy, Long Island City, N. Y., assignor to Hatfield Wire & Cable Co., Hillside, N. J., a corporation of New Jersey.

A covering strip is helically wound about the conductor, with each turn embracing the web of a preceding turn, this web of the strip protruding from the main body of the strip.

(Please turn to Page 234)



20" x 60" Three-High Breaking-Down and Roughing Mills with feed table and oval repeater.

FARREL ROD MILLS

Give Increased Production with Lower Rolling Costs

Farrel Rod Mills are designed for high speed operation, with low power consumption and minimum labor. Maximum power savings are secured through the use of anti-friction bearings. Labor is reduced by automatic handling equipment, permitting a small operating force. Proper design assures minimum scrap and a diversified product of high quality.

Other advantages of Farrel Rod Mills are more effective and economical lubrication; smooth, quiet operation and low maintenance cost. Higher output can be more consistently maintained because of fewer interruptions to production.

The Farrel breaking-down and roughing mills illustrated are completely equipped with feeding table, lift table, stop gate, turning guides and repeaters. Complete control of all passes and operations, from heating furnace to the first pass in the finishing train, is in the hands of a single operator in the pulpit.

This unit is part of a complete plant designed by Farrel engineers, including a nine-stand intermediate and finishing train with automatic looping repeaters for two passes and automatic feeding features. Thus the complete mill can operate with a minimum of hand labor.

We are prepared to design and install complete rod mills from furnace to coilers for any required output.

FARREL

FARREL-BIRMINGHAM COMPANY, Inc.
ANSONIA, CONN.
New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

Why Production Managers like Duriron Equipment:

Because Duriron Equipment helps them get out Production!

Funny thing about a Production Manager—at rush times or in slack seasons, he has his production worries just the same, getting the stuff out on schedule.

Where corrosion is a problem, the Production Manager is thankful if he has Duriron equipment — pumps, valves, pipe and fittings, circulating and heating jets and other Duriron equipment. He can count on it delivering the goods consistently, in full volume, free of contamination.

If **YOU** are a Production Manager — give yourself a break! Put Duriron equipment on the acid jobs, or wherever there is corrosion. Then you'll know that there is at least one place that won't be a bottle neck.

Write for Bulletins on Duriron equipment

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Dies for
High Speeds
Long bearing Dies
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Special bearing Dies

FAMOUS
WIRE DRAWING DIAMOND DIES

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Largest Stocks in U.S.A.
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Safest Guarantees
Best Selections
Lowest Costs

Index to A.S.T.M. Standards

THE latest edition of the Index to A. S. T. M. Standards and Tentative Standards just published gives information on all of the 870 standards as of January 1, 1939. The Index is of service to anyone wishing to ascertain whether the Society has issued standard specifications, test methods, or definitions covering a particular engineering material or subject and it is of help in locating the standards in the volumes where they appear.

✦ ✦ ✦

ALL items are listed in the Index under appropriate key-words according to the particular subjects they cover. As a convenience a list is given of the specifications and tests in numeric sequence of their serial designations. Copies of this publication are furnished without charge on written request to A. S. T. M. Headquarters, 260 S. Broad St., Philadelphia.

A Review of Recent Wire Patents

(Continued from Page 233)

NO. 2,147,402, ELECTRIC CABLE, Patented February 14, 1939 by Irving T. Faucett, Westerleigh, N. Y., assignor to General Cable Corporation, New York, N. Y., a corporation of N. J.

The assembly includes a wall of porous insulation around the conductor, an elastic, non-metallic sheath comprising a layer of a compound of an olefin polysulfide reaction product enclosing the insulated conductor, a body of fluid insulating material filling the porous insulation and all spaces within the cable sheath, a fluid-tight pipe enclosing the cable, the internal diameter of the pipe being large enough relative to the overall dimension of the cable to permit the cable being drawn into the pipe, and a body of fluid under pressure filling the space between the sheathed cable and the wall of the pipe and pressing against the elastic sheath tending to force the fluid insulating material into the porous insulation under pressure.

✦ ✦ ✦

NO. 2,147,899, METHOD OF MAKING SELF-LOCKING SCREWS, Patented February 21, 1939 by Joseph H. Hoern, Saginaw, Mich., assignor, by mesne assignments, to Eaton Manufacturing Company, Cleveland, Ohio, a corporation of Ohio.

This method is provided to manufacture the screws disclosed in U. S. patent No. 2,099,897.

✦ ✦ ✦

NO. 2,148,118, SPRING ASSEMBLY FOR UPHOLSTERY, Patented February 21, 1939 by William W. Gleason, Chicago, Ill., assignor to Nachman Spring-Filled Corporation, Chicago, Illinois, a corporation of Illinois.

The invention lies in the provision of strip receiving casings for springs of wire spring assemblies known generally as the Marshall type.

✦ ✦ ✦

NO. 2,148,380, WOVEN WIRE FENCING, Patented February 21, 1939 by Julian L. Schueler, Kokomo, Ind., assignor to Continental Steel Corporation, Kokomo, Ind., a corporation of Indiana.

So that animals will discern an all wire fence when in position, the inventor colors certain of the wire strands a color contrasting with the general color of the wire.

✦ ✦ ✦

NO. 2,148,526, METHOD OF TREATING INSULATED ELECTRICAL CONDUCTORS, Patented February 28, 1939 by Samuel E. Brillhart, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of N. Y.

A thin coating of paraffin is applied to the rubber sheath of the wire conductor. The method permits the coating to be applied cold so that there is a minimum of absorption of paraffin.

✦ ✦ ✦

NO. 2,148,889, BEDSPRING, Patented February 28, 1939 by William E. Wunderlich, Muncie, Ind., assignor to The Moore Company, Muncie, Ind., a corporation of Indiana.

Helical cross wire ties are arranged to connect the large helical spring of the bedspring assembly.

STEEL REELS AND DRUMS
for
WIRE AND CABLE INDUSTRY
R.B. HAYWARD CO.
1714 Sheffield Ave. Chicago, Ill.

TUNGSTEN CARBIDE DIES BY WILLEY'S

A **SPECIAL Grade of Tungsten Carbide, (covered by U. S. Patents) with the proper characteristics for Dies—free from porosity—offers great resistance to abrasion and takes a polish equal to diamonds.**

These and other important characteristics make this metal ideal for sizing, extrusion and wire drawing Dies.

Sales Engineers in principal cities.

Write for bulletin showing specifications and latest prices.

WILLEY'S
CARBIDE TOOL CO.
MANUFACTURERS AND SPECIALISTS IN
TUNGSTEN CARBIDE TOOLS
1540 W. VERNOR HIGHWAY • DETROIT, MICHIGAN

NO. 2,149,238, WIRE SPOOLING MACHINE, Patented February 28, 1939 by John Adolf Borck, Nutley, N. J., assignor to Eastwood-Nealley Corporation, Belleville, N. J., a corporation of N. J.

Spool carriers are provided which permit the spools to rest upon and be driven by a belt, but adjustable to a limited extent by means of rods carrying wire guiding means.

✦ ✦ ✦

Rod Handling by Overhead Tramrail

(*Continued from Page 213*)

the new, or No. 2 Rod Mill, also handles the output from the older, No. 1 Mill. The rod bundles from the latter are delivered by a separate hook carrier to a point on a tramrail adjacent to the cleaning and baking division. They are removed from the hooks by hand operated lifts, instead of by lifts operated by compressed air as used in No. 2 Mill. From this point, however, the procedure is the same as described. The tramrail system is more than adequate to handle the total output of both mills.

✦ ✦ ✦

Charles M. Grannis and R. J. Perkins

MESSRS. Chas. M. Grannis and R. J. Perkins have been appointed service engineers by Carboloy Co., Inc., of Detroit, Mich.

✦ ✦ ✦

MR. GRANNIS has had 26 years of practical experience in the metal working field, covering ten years spent in the designing and producing of tools, four years as general foreman of the Lamson Company, nine years with the R. L. Crane Machinery Company as sales engineer and three years as sales and service engineer for the Vascoloy Ramet Division of Vanadium Alloys Steel Company.

✦ ✦ ✦

MR. PERKINS has been associated with the metal working industry for 28 years. An initial period of five years spent in machine shops, tool rooms and foundries was followed by two years of special tool and machine design work for the Michigan Crankshaft Division of General Motors. For the past 21 years he has been with the Reo Motor Car Company—16 years as assistant chief inspector and five years as chief inspector in charge of tool and gage design.

A BIG MESSAGE
in little space:

Whatever your pickling problem may be, there is a grade of RODINE, the world-wide inhibitor, that will give you perfect pickling. Our laboratories work unceasingly in your service —and without charge.

If you have any metal-treating problem — pickling, cleaning, rust-proofing, painting — we will gladly work with you to solve it.

American Chemical Paint Co.
Box 306, AMBLER, PENNA.
Detroit, Mich. Walkerville, Ont.

There is **MORE** quality in the diamonds used for making Rusch Wire Dies,

MORE accuracy in making Dies the Rusch scientific way,

MORE uniform wire produced throughout the life of Rusch Wire Drawing Diamond Dies!

YET prices are low and service always dependable.

For further particulars address

RUSCH WIRE DIE CORP.
275 Seventh Ave., New York, N. Y.

Learn about PARALAN

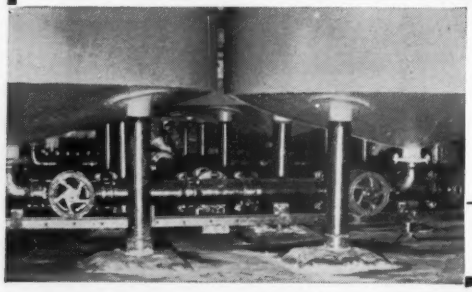
Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

AMERICAN LANOLIN CORP.
LAWRENCE, MASSACHUSETTS

Fight *corrosion* with HAVEG Pipe Lines

CAN BE CUT AND FITTED on the job—CHEMICALLY SATISFACTORY even with hot solutions — REASONABLY PRICED.



Is your acid handling problem

ACETIC — SULPHURIC
PHOSPHORIC—HYDROFLUORIC
HYDROCHLORIC ?

To mention but a few of the acids HAVEG can handle. Get the facts—send for Bulletin WP-A1.

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NEWARK DELAWARE

WIRE NAIL MACHINERY

These machines are made in eleven different sizes. This enables us to cover any size of nail most efficiently.

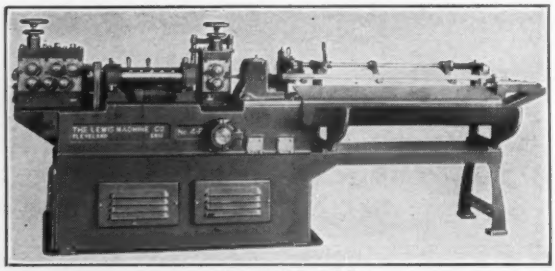
GLADER Nail making machines have been adopted as standard equipment in all recent major nail mill installations.

For further information, prices, etc., write to us.

Wm. Glader Machine Works

210 N. RACINE AVENUE, CHICAGO, ILL.

LEWIS Wire Straightening and Cutting Machines
— Automatic—High Speed — Heavy Duty —



No. 4-F Travel-Cut

Machines to Handle
1/32" to 3/4" Rod
Round - Square - Flat - Hex
Ferrous and Non-Ferrous

Write For Bulletin

The Sign of Dependable Service:
WE CAN SUPPLY AND ENGINEER OUR TOOLS EQUIPPED WITH CARBOLOY CEMENTED CARBIDE

THE LEWIS MACHINE CO., 3440 E. 76 ST., CLEVE., O.

Westphal Re-elected President of Wire Association

(*Continued from Page 209*)

IN chronological order, the Regional Meetings will be as follows:

April 5, 1939, New York City.

Inspection Signal Section, Army Base, Brooklyn, New York.

National Industrial Preparedness Dinner, Waldorf Astoria Hotel, New York, 7:00 p. m.

Association headquarters at Waldorf Astoria Hotel, New York, all day.

✦ ✦ ✦

April 25, 1939, Worcester, Massachusetts

Headquarters of Wire Association at Hotel Bancroft.

1:30 p. m., visit to plant of The Norton Company.

6:00 p. m., informal dinner at Hotel Bancroft.

7:30 p. m., Wire Association meeting at Hotel Bancroft.

Paper: "Trouble Shooting With Metallography," by C. G. Johnson, Assistant Professor of Mechanical Engineering, Worcester Polytechnic Institute.

Paper: "Applications of Norton Products in the Wire Industry."

Papers to be followed by informal discussions on subjects presented.

✦ ✦ ✦

May 5, 1939, Pittsburgh, Pennsylvania

Wire Association headquarters at William Penn Hotel.

A. M., meet at hotel for bus trip to East Pittsburgh.

12:30 p. m., luncheon served at the East Pittsburgh plant of the Westinghouse Electric & Manufacturing Company, by courtesy of that company.

2:00 p. m., plant inspection of Westinghouse Electric & Manufacturing Company.

6:00 p. m., informal dinner at William Penn Hotel.

7:30 p. m., Wire Association meeting.

Titles of papers to be presented to be announced by letter to members of the Wire Association upon completion of the program.

October 23-27, 1939, Annual Convention and Exposition, in association with the National Metal Congress, Chicago, Illinois.

Headquarters of Association will be at the Congress Hotel for the week.

An excellent program of papers and plant visitations is now being arranged for by the joint program committee of the Association.

✦ ✦ ✦

CARDS of Admission for any or all of the Regional Meetings may be obtained upon request from the Secretary of the Wire Association.

✦ ✦ ✦

The Annual Medal Awards of the Wire Association

For the Most Meritorious Paper On Wire Manufacture or Fabrication During the Year

ALL members of the Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association Meeting at Chicago, October 23-27, 1939.

✦ ✦ ✦

FOR 1939 and subsequent years a medal will be awarded in each of the two major divisions of the activities of the Association, to the papers coming nearest to the requirement set forth above.

✦ ✦ ✦

CONSIDERATION for the Medal Awards is not limited to the papers presented at the Annual Meeting, but is given to all papers submitted by members and published in "WIRE & WIRE PRODUCTS" during the year.

✦ ✦ ✦

SELECTION of papers to be presented at the Annual Convention rests in the hands of the Joint Program Committee of the Wire Association.

✦ ✦ ✦

ALL papers submitted become the property of the Wire Association, and the Board of Directors constitutes the Committee on Awards.

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ADDITIONAL information may be obtained by addressing:
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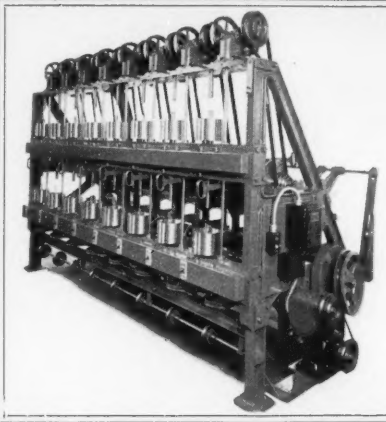

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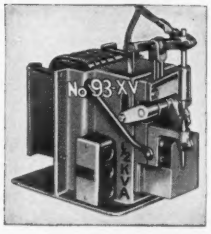

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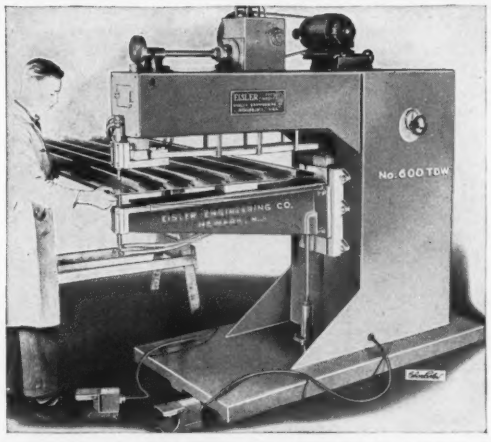

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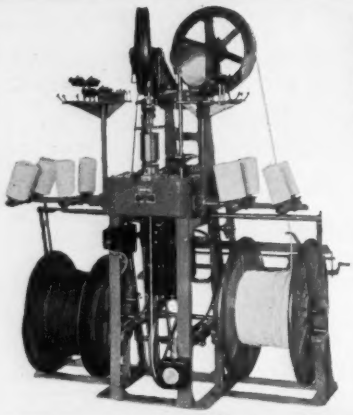

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Exports and Imports of Wire

(*Continued from Page 228*)

CARD CLOTHING receipts totaled 20,675 square feet valued at $32,126 against 13,716 square feet valued at $21,568, and came from the United Kingdom (17,817 square feet at $26,391), Belgium (2,412 square feet at $4,661), Switzerland (237 square feet at $770), and Germany (209 square feet at $304).

✦ ✦ ✦

RECEIPTS OF WIRE HEDDLES—none.

✦ ✦ ✦

A TRADE of 90,010 square feet resulted in WIRE CLOTH AND SCREENING as against 31,321 square feet and came from Belgium (52,297 square feet); Germany (22,244 square feet); Netherlands (10,633 square feet) and Canada (4,512 square feet).

✦ ✦ ✦

FOURDRINIER AND OTHER PAPER-MAKING WIRE — none.

RECEIPTS OF WIRE FENCING AND NETTING, galvanized before weaving, amounted to 1,068,986 square feet and came entirely from Germany. Of that galvanized after weaving, the total was 2,768,874 square feet against 2,167,500 square feet, and came from Germany (1,269,624 square feet); Belgium (1,160,250 square feet) and Netherlands (337,500 square feet).

✦ ✦ ✦

EXPORTS OF iron and steel wood screws during January, 1939 totaled 18,874 gross, valued at $3,569. Of this total, Mexico took 4,820 gross valued at $589; Finland, 4,345 gross valued at $1,543; Canada 3,764 gross valued at $294; Australia 1,522 gross valued at $216.

✦ ✦ ✦

EXPORTS OF BRASS WOOD SCREWS during the same month totaled 5,145 gross valued at $1,923. Of this total Mexico took 1,650 gross valued at $341.

✦ ✦ ✦

IMPORTS OF WOOD SCREWS DURING the same month totaled 4,533 gross valued at $779.

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Patent Issued for Tungsten Carbide

PATENT No. 2,147,329 has been recently issued to Mr. F. H. Willey, President of Willey's Carbide Tool Company, Detroit, Michigan, which relates to a new Tungsten Carbide suitable for tipping tools for turning ferrous and non-ferrous alloys. Also suitable for drawing dies, extrusion dies and other wear resisting parts. Copy of patent will be sent to anyone interested.

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Essential Steps in Halting the Long-Term Decline in Durable Goods Industry

OBSERVERS are generally in accord that the foremost problem for 1939 is the transition from a pump-priming recovery to a true, long-term business recovery. It is likewise accepted in management circles, and seemingly on the way to being accepted in government circles, that such a transition cannot occur without a recovery of the durable goods industries and a resumption by them of a normal rate of growth, according to business economists Allen W. Rucker and N. W. Pickering in a study just issued by Farrel-Birmingham Company, Inc., of Ansonia, Conn.

✦ ✦ ✦

"IN 1923 and 1929," continue the authors, "the relative shares of manufacturing income of the durable and light goods divisions of manufacturing were fairly constant. That constancy accounts in substantial measure for the stability of that period. In 1923 heavy industries (forest products, iron and steel, machinery, non-ferrous metals, railroad repair shops, transportation equipment, stone, clay and glass products and miscellaneous industries) accounted for 53.13% of total manufacturing income, as measured by Value Added by Manufacture; light industries accounted for 46.87% of total income. In 1929, the heavy industry division received 53.41% of total income; the light division received 46.59%.

✦ ✦ ✦

"IN 1935 the durable goods group received only 45.37% of total manufacturing income, whereas the share of the light goods division climbed to 54.63%, a marked contrast with the 46.87% of 1923."

✦ ✦ ✦

MESSRS. Rucker and Pickering state that, "It is possible to compute with some accuracy what this change in the relative shares of the heavy and light industry groups has meant in terms of dollars. Had the recovery of the light goods division represented, not 54.63% of total manufacturing income, but the more normal 46%, it would have required that the durable goods industries receive upwards of 3.5 billion dollars more gross income than they actually did receive. Put another way, total Value Added in Manufacturing should have been 24.30 billion dollars in 1935 instead of the 20.83 billions actually shown.

"THE difference between the two figures represents the estimated loss of income suffered by eight industry groups engaged in producing other than consumable products. That loss is traceable in substantial part to the diversions of capital and credit from its customary economic channels and into channels of an unproductive nature.

✦ ✦ ✦

"THE failure of payrolls of heavy industry to recover translates itself into dollars to the extent of some $1.80 billions. That is, had that division of industry revived in pace with the light division, total payrolls in manufacturing in 1935 might well have been 9.34 billion dollars instead of the 7.54 billion dollars actually disbursed. This figure of $1.80 billions is the estimated loss for a single year. What the loss might total for the years from 1933 to 1938 can only be guessed. It is probably not far short of ten billion dollars."

✦ ✦ ✦

THE authors add, "Had employment opportunity in the durable goods branch of manufacturing kept pace and absorbed its normal proportion of total workers in 1935, it seems likely that total employment in that year would have been upwards of nine million wage earners instead of the 7.34 million persons actually on the payrolls."

✦ ✦ ✦

IN conclusion, Messrs. Rucker and Pickering list five steps needed to stimulate a healthy and sustained revival of durable goods industry, as follows:

1. **"Cessation of Government competition with private enterprise in all fields—especially in those where that competition has probably diminished the total of production, income and employment.**
2. **"Renunciation of the policy of regulative taxation, either punitive or incentive, and resumption of a policy of taxation for revenue only.**
3. **"Cessation of experiments calling for or resulting in a restriction of private investment, freedom of individual enterprise and a limitation of productive effort.**
4. **"Curtailment of Federal monopoly of demand upon savings and its continued absorption of capital and credit for deficit financing.**
5. **"Encouragement of class cooperation rather than class cleavage, and the modification or repeal of discriminatory and class legislation."**

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H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Sinfra Corp., Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sinfra Corporation, Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.
Sinfra Corporation, Jersey City, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY — Measuring Wire & Cable
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Royle, John, & Sons., Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY— Special — Combination Machine for Drawing, Cutting-to-length. Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Halden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Size of Wire
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y. Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Welding Wire
Eisler Engineering Co., Inc., Newark, N. J.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Youngstown, O.
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

WHERE TO BUY, Continued

W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., The, Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS
American Chemical Paint Co., Ambler, Pa.

PIPING AND FITTINGS—Acid Resistant
Duriron Co., Inc., The, Dayton, O.
Haveg Corp., Newark, Del.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Steel
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS AND SPOOLS—Shipping and Shop
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REELS—Wire Drawing
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.

SPOOLS—Annealing and Wire Drawing
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Shipping and Shop
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Steel
Hayward, R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non Ferrous
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

SWIFTS—Take-off
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y. Co., Phila., Pa.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE—Steel—Also Coppered Steel——Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

WIRE AND STRIP—Zinc
Metal Industry Works, Poland.
Platt Bros. & Co., The, Waterbury, Conn.

ZINC—Slab
St. Joseph Lead Co., Josephtown, Beaver County, Pa.

THE ENGINEER LOOKS AT DESIGN

FASTER production, higher quality, greater economy, less upkeep . . . to meet these pressing demands, experienced wire mill engineers look to Morgan design and improved Morgan machines. Their ✓ simple, rugged construction affords new ✓ dependability, ✓ low maintenance costs. The high blocks, air cooling system, and other original features of Morgan-Connor Continuous Wire Drawing Machines mean ✓ increased output with ✓ uniformly high quality of all types of wire. Their compact design assures future economies—in ✓ floor space, ✓ installation costs, ✓ operating control. Every detail is worked out with typical Morgan thoroughness to make production and profits continuous.

Morgan-Connor Wire Machines; Bull Blocks, Horizontal or Vertical; Galvanizing and Patenting Equipment; and Wire Mill Accessories.

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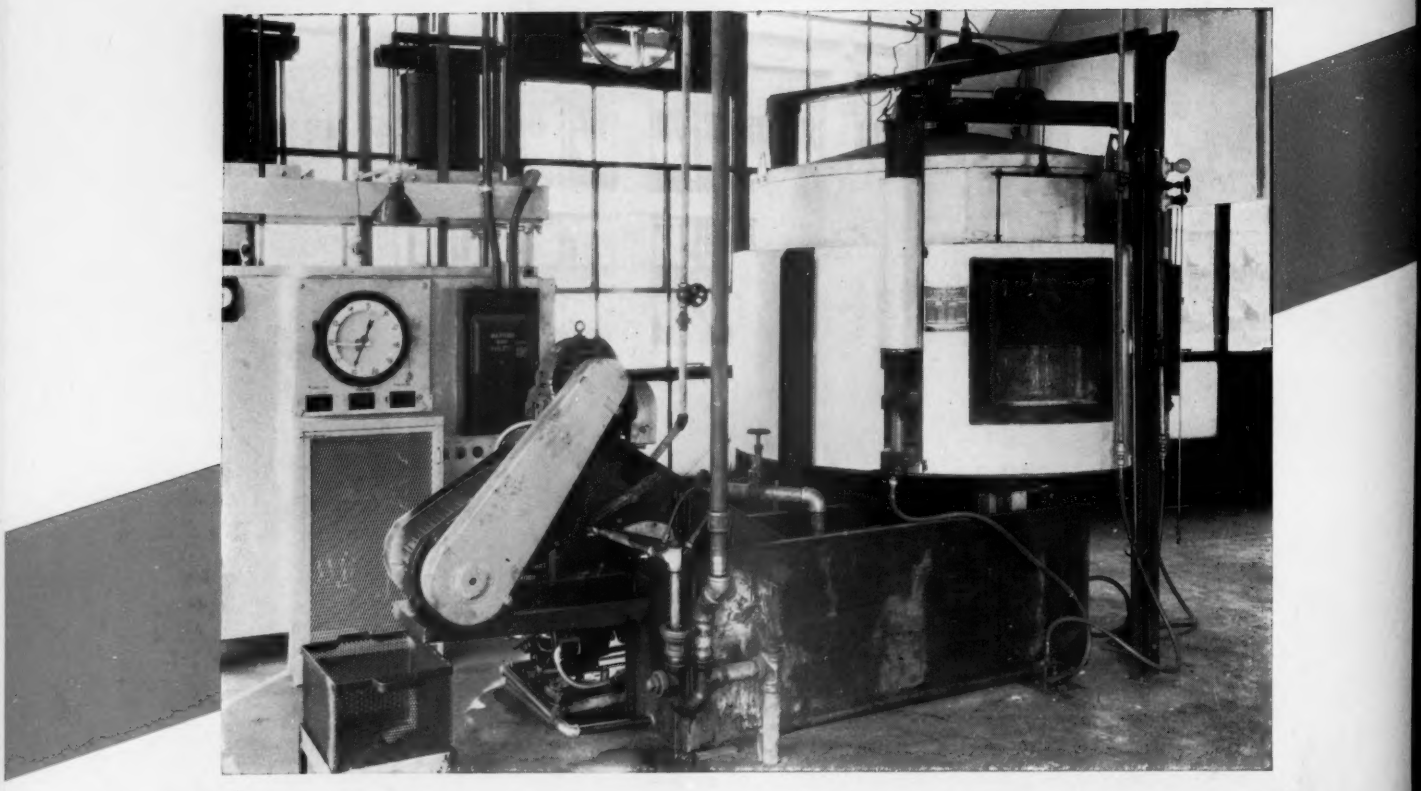
Sole European Representatives: MALMEDIE & CO., Dusseldorf, Germany

MORGAN WORCESTER ENGINEERS AND MANUFACTURERS

W36

MORGAN *Wire Drawing Machinery*



This Small Scale-Free Hardening Furnace Hardens 250 lbs. Bolts, Springs, Etc. per Hour

The Electric Furnace Company of Salem, Ohio, while more widely known as "designers and builders of large production furnaces," also build numerous smaller continuous automatic units.

These smaller furnaces incorporate the same expert engineering service and experience, and the same ruggedness and refinements which characterize their larger units.

The above rotary, scale-free hardening furnace is an excellent example. This comparatively small and inexpensive installation handles miscellaneous small and medium sized products such as springs, bolts, screws, etc., at the rate of 250 lbs. per hour.

The complete unit consists of furnace, quenching equipment, automatic controls and an Elfurno generator for supplying the inexpensive protective atmosphere for scale-free hardening.

With this equipment, the heat treating of miscellaneous small and medium sized parts and products is placed on a continuous, uniform and economical basis. The furnace has two doors and two quench tanks. The material is loaded into heat resisting alloy trays, carried around the furnace and discharged through sealed chutes to either a water or an oil quench. The drive is so arranged that the rotation of the hearth may be in either direction, thus by using opposite doors for loading, it is possible to operate the furnace in either direction and to discharge into either the oil or the water quench.

This permits considerable flexibility as the material may be either oil or water quenched from the same equipment without moving the quench tanks or changing the quenching medium. By removing the material from the trays instead of discharging into quench tanks, this furnace can also be used for drawing, annealing or other processes.

Submit your furnace problems to E. F. engineers. With years of experience and hundreds of successful electric and fuel-fired furnace installations, we have solved many difficult production furnace problems—experience which may save you considerable on your particular furnace problem.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production